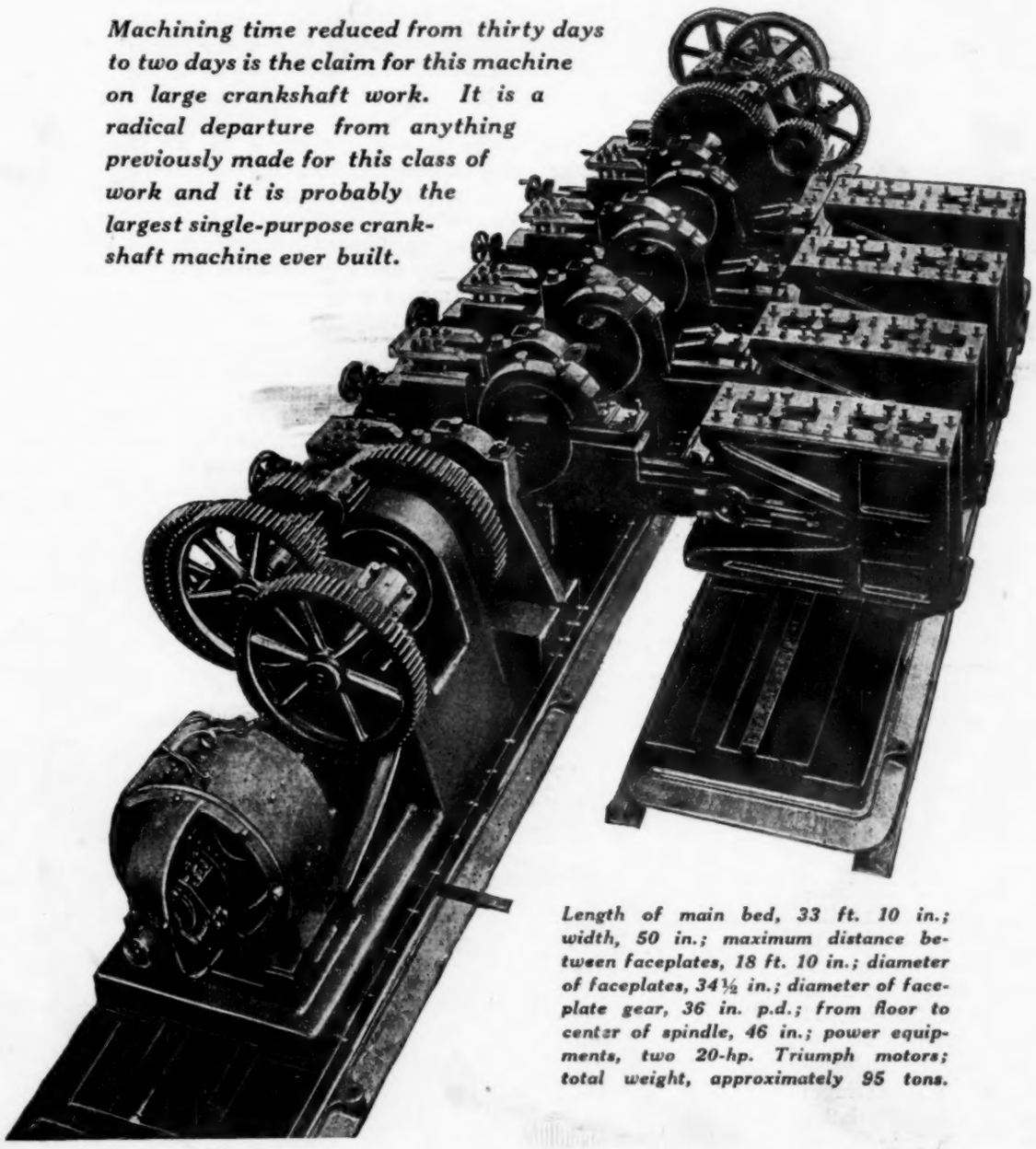
August 28, 1919 American Machinist Vol. 51, No. 9

A RECORD-SMASHING CRANKSHAFT LATHE

By ETHAN VIALL
Managing Editor, *American Machinist*

Machining time reduced from thirty days to two days is the claim for this machine on large crankshaft work. It is a radical departure from anything previously made for this class of work and it is probably the largest single-purpose crankshaft machine ever built.



Length of main bed, 33 ft. 10 in.; width, 50 in.; maximum distance between faceplates, 18 ft. 10 in.; diameter of faceplates, 34½ in.; diameter of faceplate gear, 36 in. p.d.; from floor to center of spindle, 46 in.; power equipments, two 20-hp. Triumph motors; total weight, approximately 95 tons.

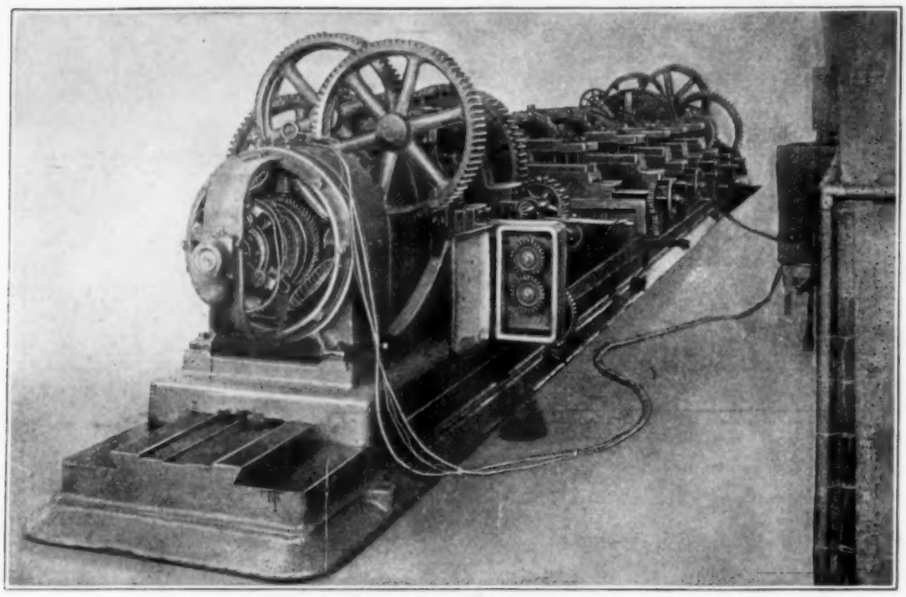


FIG. 1. MULTIPLE-TOOL CRANKSHAFT-TURNING MACHINE

IN THE summer of 1917 there was a demand for multiple-cylinder oil engines of large horsepower that far exceeded any possible supply. An investigation of the supply of component parts for these engines showed that crankshafts were the limiting element in production and that the machines available for turning them could not possibly supply the demand. The situation was made known to T. K. Webster, of Chicago, who was already supplying the market for single-purpose gun-boring and shell-making machines. He at once grasped the necessity of breaking away from established methods of producing crankshafts, in order to meet the unprecedented demand. In accordance with his wishes, designs were drawn for a machine that would efficiently perform the work of a dozen lathes on six-throw crankshafts. A small experimental machine was built to demonstrate the practicability of the suggested method. This small machine so clearly showed the feasibility of handling the work as proposed that the Crank Shaft Co., of America, Edison Bldg., Chicago, was incorporated and the huge machine shown on the first page was built. This great machine is capable of machining crankshafts of from 7 to 10 in. in diameter and any throw. It machines the sides of the webs and turns the ends of the crankpins on all of the throws at once.

An inspection of the halftones, Figs. 1 and 2, and the line cut, Fig. 3, will show that the machine has a main and an auxiliary bed. The main bed is 33 ft. 10 in. long, 50 in. wide and carries two opposing spindles, 14 in. in diameter, and tool carriages after the manner of a lathe. The height from floor to center of spindle is 46 in. Each of the opposing spindles is driven through back gears, by means of a 20-hp. Triumph variable-speed motor, with a range of 400 to 1200 r.p.m. These motors are synchronized by means of a special electrical device, so that the drive on each spindle is exactly the same at all times, and no twist is imparted to the crankshaft being machined. The faceplates are 34½ in. in diameter and the faceplate gears 36 in. p.d. The machine contains 106,000 lb. of steel castings and 81,400 lb. of cast iron, or an approximate total of over 93½ tons of castings alone.

The machine, with a four-throw crankshaft in place, is shown in Fig. 4. This crankshaft is 9 in. in diameter, 17 ft. long, with 11-in. throw, giving an engine stroke of 22 in. Finished, the total weight is over 15,000 lb. for this size of crankshaft.

In preparing a crankshaft like this for placing in the machine it is first slabbed out, blanked by drilling and sawing, twisted according to the arrangement of the throws and then centered and the concentric bearings turned in a big lathe. Heavy-flanged driving plates are then shrunk onto each end of the crankshaft, as clamps or dogs of any kind are unsatisfactory for this work. These flanged driving plates are split off after the webs and crankpins have been finished. After the flanged driving plates have been shrunk on the crankshaft, it is put into the machine, centered to run true and the driving plates bolted to the faceplates of the machine at each end. The turned parts of the crankshaft run in steadyrests as shown at *A*, the bearings of which are babbitted to fit the turned parts, which in this case are 9 in. in diameter.

It will be noted by studying the illustrations that the steadyrests, carriages and heads of the machine are adjustable and may be moved along the bed by

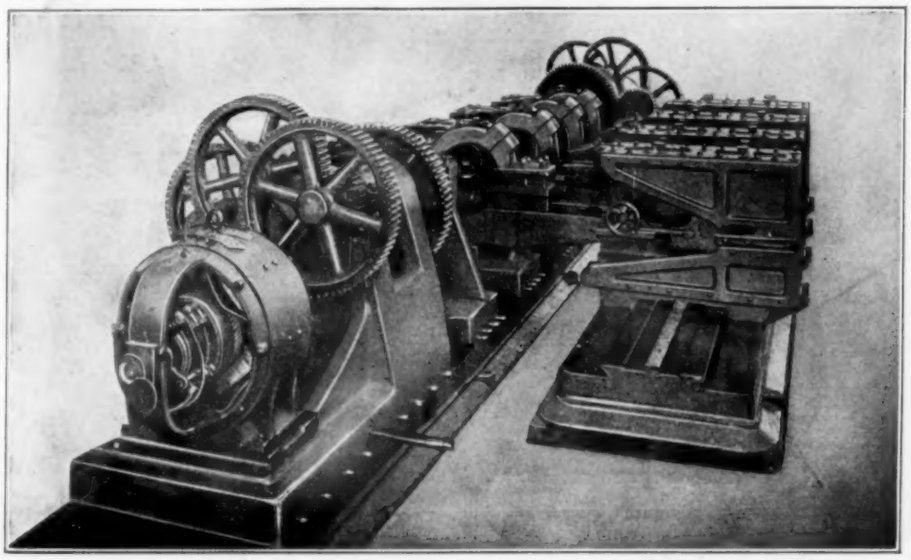
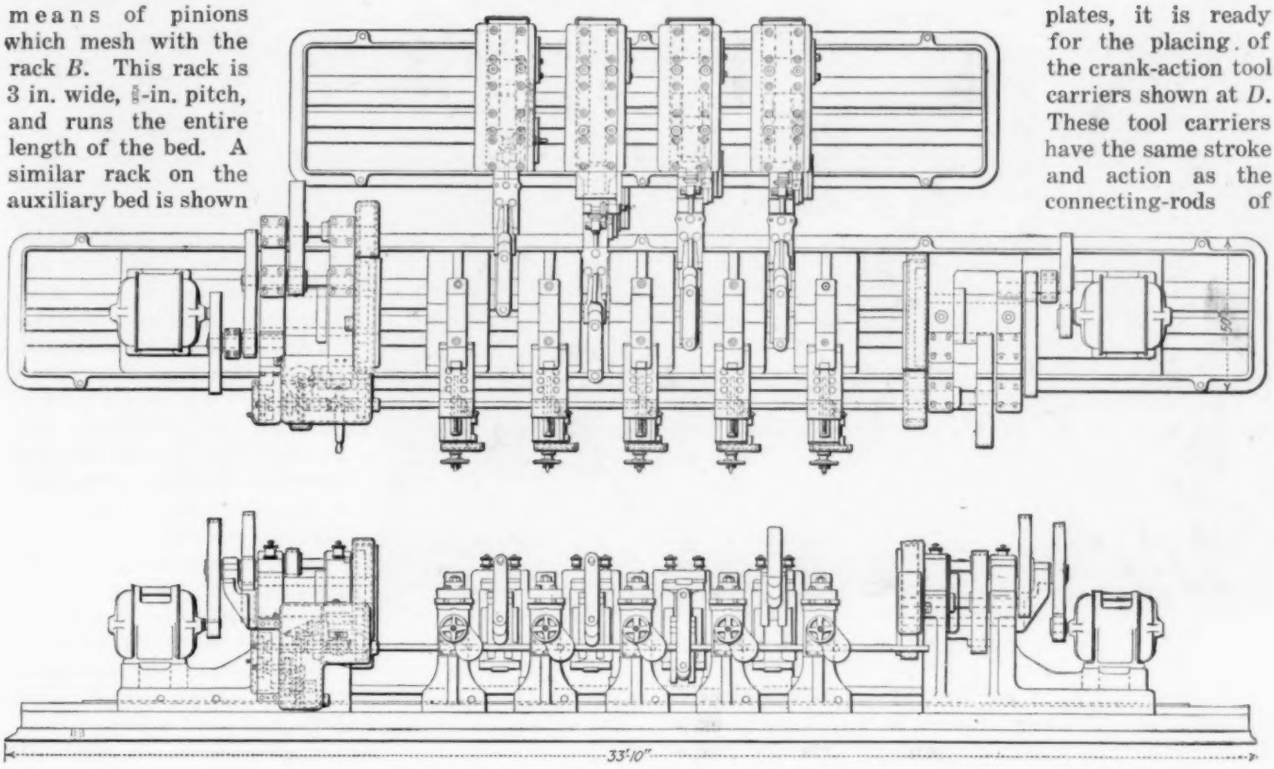


FIG. 2. VIEW OF CRANKSHAFT MACHINE FROM OPPOSITE SIDE

means of pinions which mesh with the rack *B*. This rack is 3 in. wide, ½-in. pitch, and runs the entire length of the bed. A similar rack on the auxiliary bed is shown



plates, it is ready for the placing of the crank-action tool carriers shown at *D*. These tool carriers have the same stroke and action as the connecting-rods of

FIG. 3. DETAILS OF THE MACHINE

at *C*. This is used in the adjustment of the crosshead slide housings.

After the crankshaft is in place in the babbitted steadyrests and the drivers firmly bolted to the face-plates, it is ready for the placing of the crank-action tool carriers shown at *D*. These tool carriers have the same stroke and action as the connecting-rods of the engine, and are made to machine the inside faces of the crank webs, and about one-fourth of each end and the fillets on the crankpins. This is done as the crankshaft revolves in the machine. The first tool carrier is set

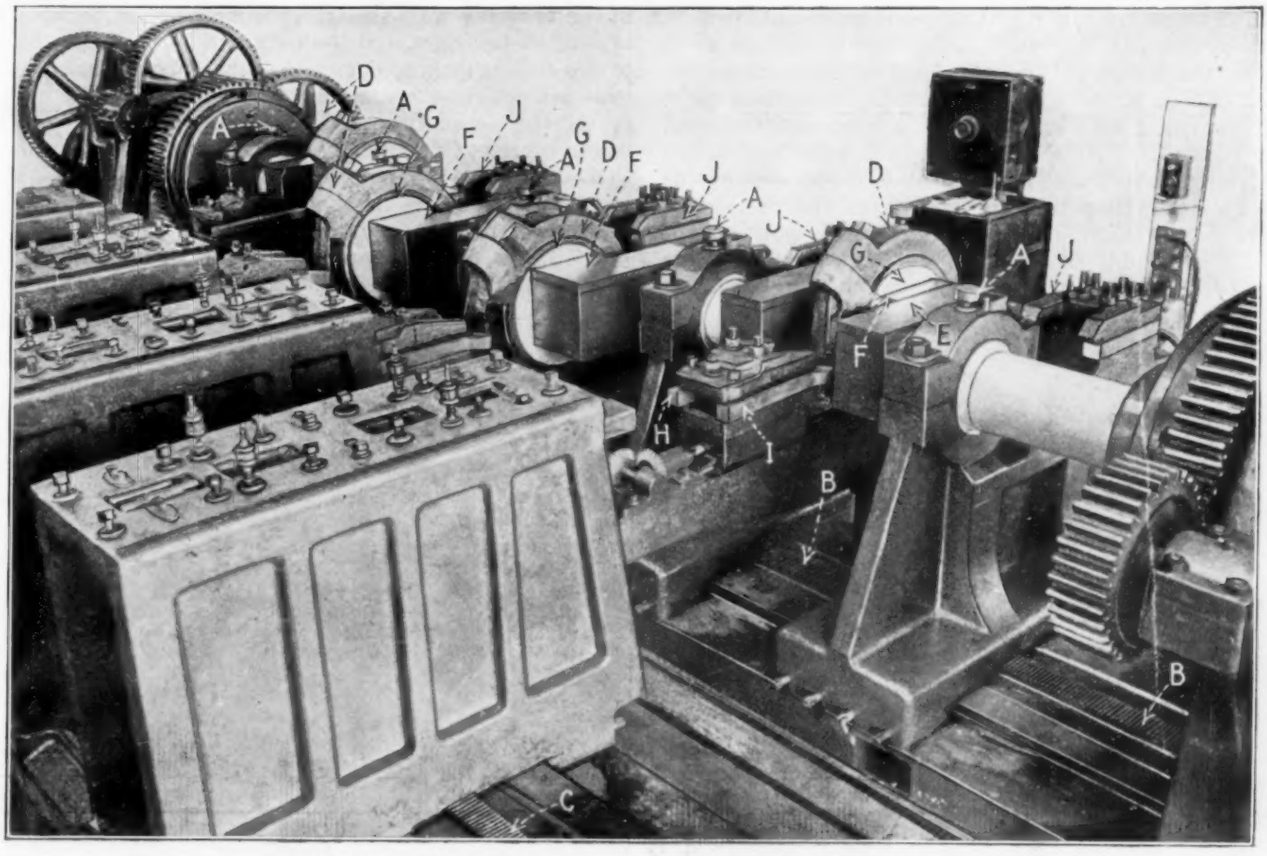


FIG. 4. THE MACHINE WITH A LARGE CRANKSHAFT IN PLACE

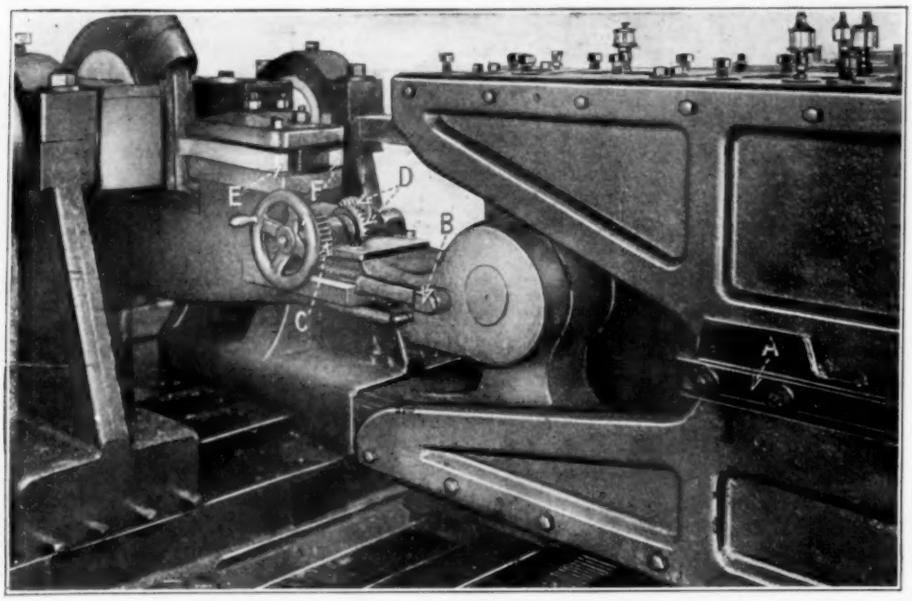


FIG. 5. CLOSE-UP VIEW OF TOOL CARRIER AND CROSSHEAD

by leveling the web of the first throw, as shown at *E*. The split head of the tool carrier is then placed around the rough crankpin. A distance piece placed underneath the split head gives the correct height for the horizontal center line of the crankpin, and setting over the correct distance from the center of the crankshaft for the throw (11 in. in this case) gives the vertical center line of the crankpin. Properly centered, the sides of the split head are luted up and pure babbitt is poured inside the head and around the middle half of the rough crankpin. In shrinking as it cools, this babbitt firmly clings to the rough crankpin, but shrinks away from the inside of the split head of the tool carrier just enough to make a good bearing. This leaves about one-fourth of each end of the rough crankpin exposed, as shown at *F*, the poured babbitt, after the luting is removed, looking as shown at *G*. The rest of the tool carriers like this are put on in the same way, care being taken, however, to correctly position the rough crankpins according to the angle of the throws of the crankshaft, which is done by indexing the right number of degrees from one of the driving spindle heads. On a crankshaft, such as shown in the machine, the setting is comparatively simple, as the pin centers are all in the same plane.

With the tool carriers all placed and the tools set, the machine is ready for starting. Referring to the first tool carrier, as the crankshaft revolves, the two tools *H* and *I* in the sliding block are automatically fed forward and machine the inside of the webs and turn down each end of the crankpin. All the other tool carriers act in the same way. At the same time the tools in the carriages at *J* feed straight in and machine the outside faces of the webs.

While in action on this crankshaft, the machine closely resembles a huge four-cylinder engine. One of the great advantages of this method of machining is that all the webs and crankpins are machined at once. In the ordinary way the whole crankshaft would have to be offset and counterbalanced for each crankpin turned. Long and more or less springy tools would also have to be used in order to reach from the toolblock past the webs to the crankpins. On the size of crankshaft shown, it is calculated that it would take 30 days to turn it in the ordinary way. On this machine the same work is done in two days, and the tools can be held close up to the cutting points, eliminating the spring, since the tools are set out the same distance from the toolblocks for all lengths of throw. This makes for quicker and better work. Of course, machined as just outlined, there is a space left unmachined in the middle of each crankpin. However, as there is an accurately turned space on each side as a guide, this part is easily finished in another machine, or can be finished in this one by putting on other attachments, such as will be indicated later.

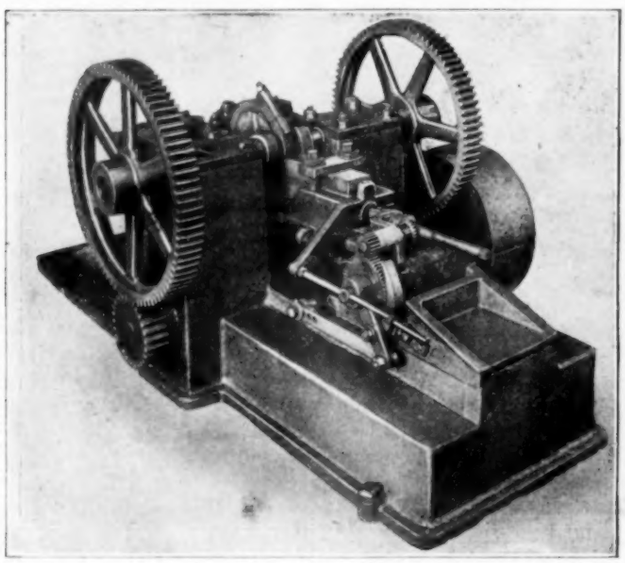


FIG. 6. VIEW OF FIRST EXPERIMENTAL MACHINE

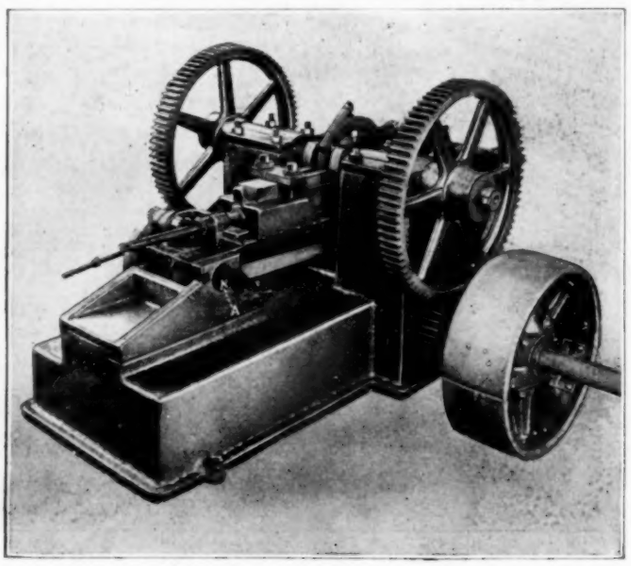


FIG. 7. ANOTHER VIEW OF EXPERIMENTAL MACHINE

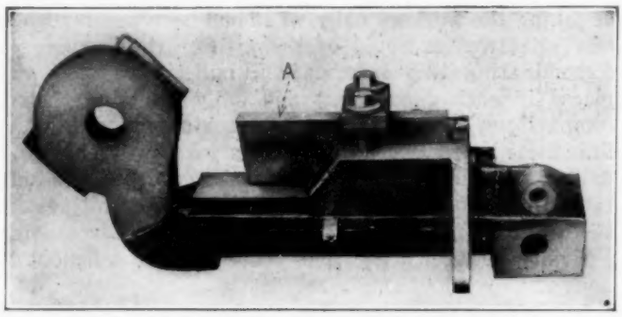


FIG. 8. THE CRANKPIN FINISHING-TOOL CARRIER

A close-up view of a tool carrier and crosshead is shown in Fig. 5. This gives a good idea of the feeding mechanism. As the cross-slide and tool carrier travel back, the adjustable stop *A* hits the roller on the end of the rack slide *B* and causes the gear *C* operating the feed screw through the bevel gears *D*, to feed in the tools *E* and *F*. A ratchet allows the rack to return, as the tool carrier moves forward, without reversing the bevel gears. Special stops throw out the feed for all tools when they have fed in the distance for which they have been set.

In studying the principle and action of the big machine, the first model built, shown in Fig. 6 and 7, will be of interest. This experimental machine has a base 22 x 56 in., and was built to machine small single-throw crankshafts about 1½ in. in diameter and 4-in. throw.

Fig. 6 shows the tool carrier and feeding mechanism, which differs but little from that of the large machine. The carriage for the tools which machine the outside of the webs is mostly hidden back of the crankshaft. Fig. 7 shows the machine from the opposite side. By removing the pivot pin *A*, the tool carrier may be removed after the ends of the crankpin have been turned. The carrier shown in Fig. 8 may then be placed in the machine and the middle of the crankpin finished with tool *A*. This is, in effect, the same method by which the large crankpins are finished.

Gaining and Holding the Interest of the Workers

By B. L. Van Schaick

Efforts to increase production or reduce costs are, as a rule, first directed toward the human factor in the shape of bonuses, premiums or similar devices, intended as an incentive to greater or more persistent effort. They are usually successful for a time, but when, as in all too many cases, the benefit to the worker is in cash alone, the effect is but temporary; he soon comes to look upon his increased earnings as a matter of course, and eventually reaches the point where a new "readjustment" is necessary, the alternative being to drift off to some other shop that seems to promise something better.

Thus, employer and employee become unusually suspicious; the first denouncing the faithlessness and disloyalty of the employee, while the latter deplores the lack of fairness and consideration shown by the employer.

Both, as a matter of fact, are at fault; but under conditions existing at present, the greater reproach is upon the employer. To be sure, the worker, dependent for the necessities as well as the comforts of life upon his only source of income, his wages, is vitally interested in the amount of his income, but at the same time it takes more than dollars and cents to create and maintain loyalty to one's employer or interest in his work. It is a fact too often overlooked that if we treat a man as a machine, we can hardly expect more than an impersonal, mechanical service regardless of the amount we pay him, and lacking the live, personal interest in the work, there can be no loyalty to shop or to the employer.

There is no magic cure for the evils of the present industrial order, but there are some things that we may do that will be of material benefit. Aside from wages, bonuses, etc., which are, of course, of primary importance, there are many other ways open to the employer who desires to interest labor, and some of these ways are at least safe, sane and not too expensive.

Between the socialistic ideal of business operated for and by the workers, and the capitalistic principle of labor as a commodity to be exploited solely for capital's benefit, there is a middle ground of common sense that requires no investment of money, but which will yield dividends to both sides.

It cannot be denied that the great majority of American industrial workers are thinking, feeling human beings and their demand for recognition as such, though often incoherent, is insistent and usually more justifiable than their clamor for more money.

Monotonous Work a Drudgery

To the average worker the day's work is a treadmill of drudgery; a task which must be gotten through with somehow; and just as this feeling becomes more pronounced, so in proportion will the cost of production move up. More supervision will be needed, labor turnover will increase and loyalty will disappear.

The apparent failure of the apprenticeship system and the abnormal demand for skilled workers during the past few years have forced many employers to establish training schools. These schools have from necessity turned out operatives understanding but one small branch of a trade, and that imperfectly; operatives capable of handling but one machine, or even of performing but one simple operation on that machine. In fact the whole trend of modern manufacturing has been toward the specialization of the worker, who seldom sees the completed product and is often ignorant of the very nature of the work he is doing.

The man of the Ford plant who makes one kind and size of bolt day after day, and perhaps does not even know in what part of the completed automobile his particular bolt is used, cannot be expected to take the interest and pride in his work that was felt by the wagonmaker of a by-gone day who built a wagon complete from thills to tailboard.

Of course, it is impossible to go back to obsolete methods; to expect the cobblers sitting upon a bench in their backrooms to supply the demand for shoes that is with difficulty met by the highly specialized shoe factories of the present day; but we can at least remove a part of the worker's drudgery by letting him see what part of the completed product his work constitutes; teaching him the importance of his one particular detail, and the necessity for the various requirements and limitations governing it.

The worker must be taken more into the confidence of the employer; must know the reason for shop rules

and regulations, which without this knowledge are sources of irritation and annoyance; must have explained to him the workings of the shop system which is too often the subject of his contempt merely because he cannot see why things are as they are. He must be made to realize his part in that system; to recognize his responsibility not only to his employer but to his fellow-workers; to know that carelessness or inattention on his part is going to adversely affect them just as similar lapses on their part will affect him.

Importance of Mutual Understanding Between Worker and Executive

When an effort is honestly made to explain to the worker the importance of his part in the system and the necessity for meeting the requirements demanded of him, he will, in nine cases out of ten, carry out his part in an intelligent manner that will reduce supervision to a minimum. If he is shown that a well-filled-out job ticket insures his receiving the proper amount of pay, he has an incentive to fill it out correctly and painstakingly. If he is made to see that submitting his work to the inspectors protects him from unjust criticism by his foreman and that similar action by other workers may prevent a direct loss to him, he will be more ready to submit it. If it is proved to him that the jigs, fixtures and tools provided for him to work with are necessary to maintain interchangeability, he will stop trying to beat them.

In any problem which affects the worker, the foreman must be taken into consideration as an important factor. As a rule, not enough care is exercised in selecting foremen. Only those men who have executive ability as well as a technical and practical knowledge of their business should be chosen; men who by reason of their tact, knowledge of human nature, and consideration for their fellows are able to get a high rate of production through the willing and cheerful coöperation of the workers.

The foreman is in a sense a buffer between the management and the men. He is the representative of each to the other and should therefore be capable of understanding the problems of both. If he does not measure up to his responsibilities in this respect, he will be the cause of constant irritation and annoyance to one side or the other if not to both sides.

Means of Adjusting Workman's Grievance

Without in any way detracting from the authority of the foreman, a means must be provided whereby a workman can personally lay before the management any grievance that may arise. This may be done through the welfare superintendent, the employment manager or, better still, through a committee made up of workers, half of whom are selected by the workers themselves and half appointed by the management. This may sound somewhat radical to some employers but if such a committee is wisely chosen and given authority only as fast as it proves itself to be capable of using it to advantage, the innovation cannot but be beneficial to both sides. Such a committee should pass upon all discharges, claims for wage adjustment and general shop complaints, and its findings should be subject to revision only by the highest shop executive.

In one large shop such a committee proved its value by preventing the defection of 18 skilled workmen within a single month. In several of the largest munition plants, shipyards, etc., the experiment was tried of telling the workers daily what had been accomplished and what was expected of them. For the purpose of disseminating this information, bulletin boards were placed in each department and daily bulletins posted, comparisons being made with previous records. At first these boards were treated as a joke by the men but daily more and more of their number stopped to study the information given thereon, and a healthy interest in the different departments was developed, finally causing a rivalry between them that proved of great benefit to both employer and employee.

The above examples are sufficient to emphasize the advantages to both sides that may accrue from taking a proper interest in and treating the workers as human beings and a part of the organization. It involves no expense; incurs no risk; requires no outlay but that of a little common sense and patience to insure satisfactory returns, but, like most lasting benefits, it may be slow in coming into its full strength and power.

A Useful Combination

By N. Renwick
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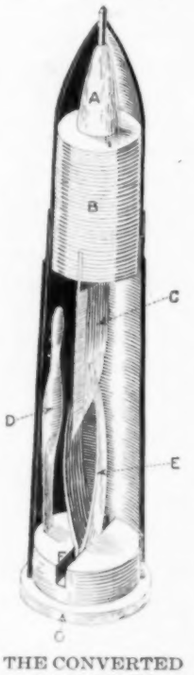
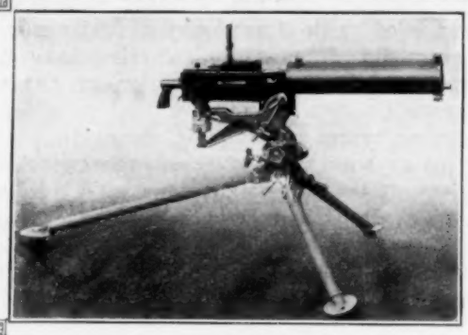
A small but useful combination, which I have used for the last two years, contains four articles which are continually required in any machine shop; namely, a pair of tweezers *E*, a knife *C*, an eye magnet *D* and a pencil *A*. The case was made from an ordinary 0.303 rifle cartridge. To make one, remove the bullet and melt out the lead from the jacket. Then drill a hole in the nose end, say $\frac{1}{16}$ in. for the pencil point to project through, and tap out rear end. Next get a $\frac{1}{4}$ x $\frac{3}{4}$-in. headless setscrew, and make the slot deeper with a hacksaw. Out of an old hacksaw blade grind the knife blade and sweat it into the slot in the screw. The bottom of the shell *G* should be cut off with as thin a tool as possible, say $\frac{1}{32}$ in. (before cutting off see that the cap has been fired). This leaves a disk $\frac{1}{2}$ x $\frac{1}{16}$ in. which is put aside till later. The remainder of the shell still has a solid bottom. This is drilled out to $\frac{3}{8}$ in. until it meets the powder chamber. Turn a piece of brass rod to $\frac{3}{8}$ x $\frac{1}{4}$ in., drill a $\frac{1}{16}$-in. hole in the position shown in the sketch for the eye magnet. Also saw a slot across the middle and sweat on to the disk *C*. The tweezers are of spring steel, made in any shape desired and sweated into the slit in *F*. The eye magnet is of $\frac{1}{16}$-in. drill rod hammered out in the middle to the flat shape shown in the sketch. This flat serves two purposes, first as clearance for the tweezers, and second as a grip when in use. The knife slides down between the tweezers. As the pencil gets worn it can be sharpened and by screwing up the screw *B* the point is always ready for use. The bottom of the shell should be pressed slightly in a vise and a few thousandths of an inch filed off the sides of the plug *F*. The bottom will then be found to go on easily one way and by a twist will tighten up and so prevent any tendency to drop out.



THE CONVERTED CARTRIDGE



HIGH PRODUCTION TOOLING METHODS

AS APPLIED TO THE MACHINE-GUN TRIPOD, MODEL 1918

By

Albert A. Dowd & Donald A. Baker

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II. Machining the Pintle of a Machine-Gun Tripod

This article relates to the tools for machining the pintle of a machine-gun tripod. Reference is made to the close tolerances on this piece and to the necessity for extreme accuracy in the tools for producing it. These tools are fully described and illustrated by drawings, and halftones are shown of some of them mounted on the machines on which they are used. A detailed description of the method of using the tools is also given.

IN TAKING up the various problems connected with the tooling of the machine-gun tripod, model 1918, let us first consider the tools for the pintle, a drawing of which is shown in Fig. 22. Reference to the illustration will make evident the necessity for great accuracy on some of the dimensions, and a careful study of it will make it apparent just why such careful tooling is necessary in some of the operations. For example, the shoulder distance 2.635 in. is held to limits of ±0.001 in.; the diameter of the small hub 0.8745 in. has a tolerance of only 0.0005 in., the dimension being given as 0.8745 $\begin{matrix}+\ 0.0000 \\ -\ 0.0005\end{matrix}$. Also, the diameter 1.999 in. must be made to $\frac{+\ 0.0000\text{ in.}}{-\ 0.0005\text{ in.}}$. The pitch diameter of the wormwheel 5.093 in. and the root diameter 5.001 in. are held to ±0.0005 in.

SEQUENCE OF OPERATIONS

1. Inspect casting.
2. Grind off gates.
3. Sandblast.
4. Hold by outside of segment end in special two-jaw chuck:
   (a) Rough-turn 0 in. in diameter; rough-turn 2.040 in. in diameter; rough-turn 0.915 in. in diameter; spot drill end; rough-bore and face 4.210 in.; rough-face both sides of flange; rough-straddle shoulders 0.580 in.
   (b) Finish-turn 2.009 in. in diameter; finish-turn 0.885 in. in diameter; finish-bore and face 4.240 in.; rough-face end 0.885 in. in diameter; finish-face both sides flange; finish-straddle 0.560-in. shoulders.
   (c) Size 1.999 in. in diameter; size 0.8745 in. in diameter; size 4.250 in. in diameter; finish-face end of 0.875 in. in diameter; form worm-gear blank.
   (d) Drill hole for ¼-in. tap.
   (e) Tap ¼-13 hole.
5. Straddle-mill segment end.
6. Stationary drill jig; drill and ream ⅜-in. hole using 39/64-in. drill and ⅜-in. reamer.
7. Mill ratchet teeth on segment end.
8. Drill 0.246-in. hole.
9. Drill 0.128-in. hole.
10. Stamp figures and graduations.
11. Hob the worm gear.
12. Test worm gear.
13. Inspect.

The fourth operation is done on a No. 2A Warner & Swasey turret lathe in which the work is first held by the outside of the segment end in a special two-jaw chuck, an assembly drawing and sectional view of which is shown in Fig. 23. It has two jaws *A* and *B*, the jaw *A* being fixed and held in position by the screw *C*. The jaw *B* is operated by screw *D*, and is provided with a rocker *E*, which adapts itself at *F* to the more or less irregular portion of the work.

Due to the fact that the work is finished at *G* and *H* in this setting, it is necessary to make the chuck jaws in such a way that the tools in this cross-slide

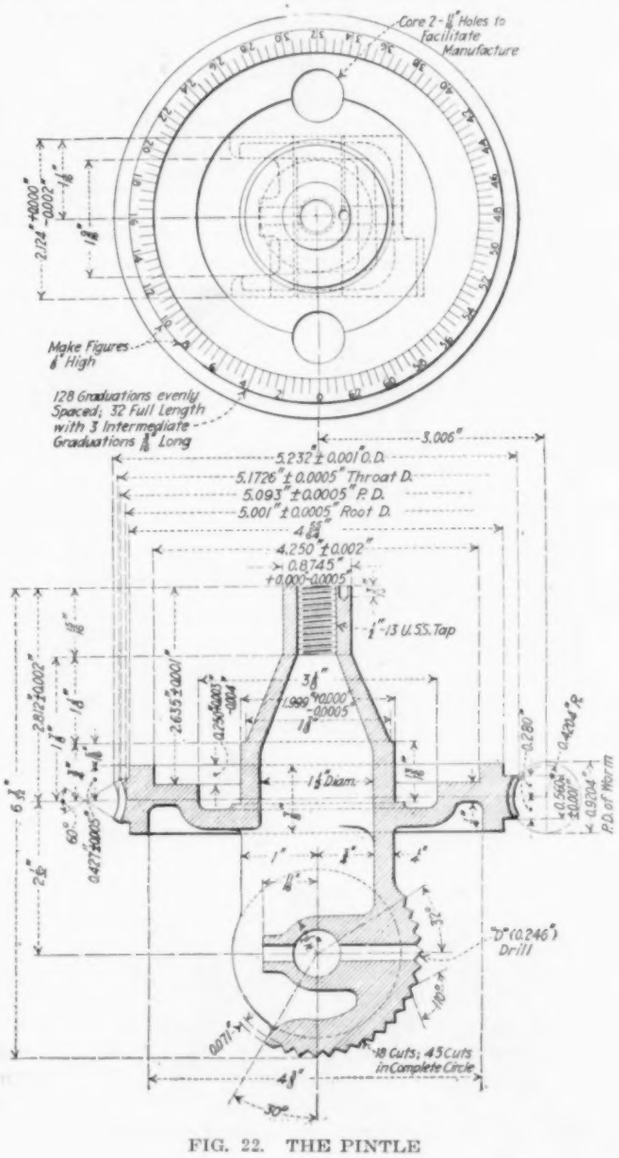

Core 2-¼" Holes to Facilitate Manufacture
Make Figures ⅛" High
128 Graduations evenly Spaced; 32 Full Length with 3 Intermediate Graduations ⅜" Long
3.006"
5.232" ± 0.001" O.D.
5.1726" ± 0.0005" Throat D.
5.093" ± 0.0005" P.D.
5.001" ± 0.0005" Root D.
4.250" ± 0.002"
0.8745" +0.000 -0.0005
¼"-13 U.S.S. Tap
1.999" +0.000 -0.0005
1½" Diam.
2.635" ± 0.001"
"D" (0.246") Drill
18 Cuts; 45 Cuts in Complete Circle
30°

FIG. 22. THE PINTLE

can pass by the flange *G*, in order to finish it. In order to keep the overhang on the spindle as small as possible, no faceplate for the chuck is used, but the chuck is made to be screwed directly on the spindle at *K*.

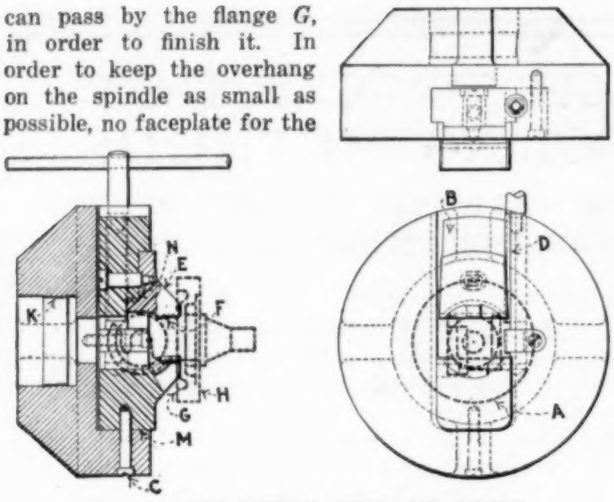


FIG. 23. THE SPECIAL TWO-JAW CHUCK

Provision is made in the chuck for removing the jaw *A* and grinding off the surface *M* in order to center the work accurately, if it is found that the castings run oversize. It is also evident that paper could be placed under the jaw to bring it nearer to the center if the castings tended to run small. Attention is called to the method of preventing lift on the rocker *E* by means of the circular tongue *N*.

The number of cuts necessary on the flange and worm-gear portion of the work *A*, shown in Fig. 24, and the extreme accuracy required, together with the high production needed, made it necessary to design a special indexing cross-slide turret. By referring to Fig. 22, the accuracy required on this portion of the work will be apparent.

The indexing turret as made is shown in Fig. 24. In order to face both sides of the flange and also the two shoulders, at the same time, four tools were used, as shown at *C*, *D*, *E* and *F*. The two outer tools *C* and *D* are grooved, and the two inner tools *E* and *F* are tongued to fit the groove. Provision is made for setting the tools accurately by means of the swinging gage *L*.

Another group of tools exactly like that just described is arranged on the opposite side of the turret at *O*, and these tools are also provided with a gage which is shown in position at *P* ready to set the tools into it after they have been ground. In action, the first or roughing tools are used and the turret is indexed 180 deg., after which the finishing tools complete the work on the sides and shoulders of the piece. The tool *Q* is used to form the worm gear. A reference to the tool layout, shown in Fig. 25, will show that the turning tool is used on the outside diameter of the work, prior to the dovetail forming-tool cut, so that this tool does not strike the rough casting, but is only used after all excess metal has been removed by the turning tool.

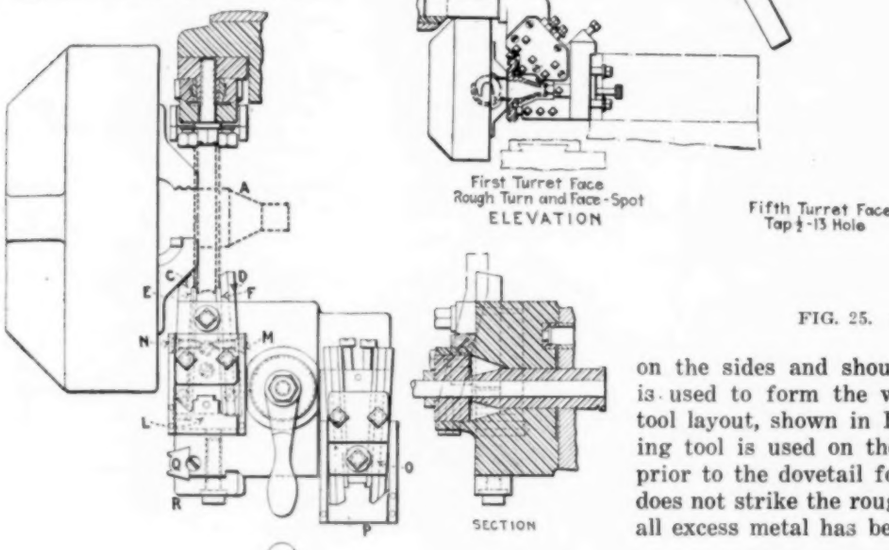


FIG. 24. THE INDEXING TURRET

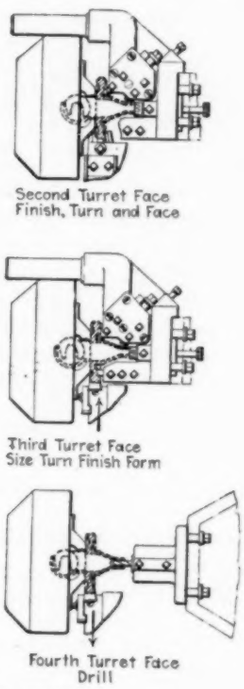


FIG. 25. THE TOOL LAYOUT

Overhead-Piloted Turning Tool

When very close work is required in turning diameters, it is evident that a very small error in the position of the turret tools will make quite a perceptible difference in the diameters of the work. In order, therefore, to overcome, as far as possible, any variations which might be caused by indexing of the turret, the overhead-piloted turning tools, shown in Fig. 26, were used for this work. Three tools of this kind were provided and three cuts taken on the diameters. These

tools are plainly indicated in the tool layout shown in Fig. 25 and in the detail of the overhead turning tool in Fig. 26.

The methods of supporting and guiding the pilot of the overhead turning-tool is plainly indicated by the drawing of the pilot bracket shownin Fig. 27. This bracket is designed so that it is fitted. The cast-iron bushing spindle cap to which it is fitted. The cast-iron bushing *C* is arranged to receive the pilot of the turning tool, this bushing being firmly clamped by means of the binder screw *D*. The position of one of the levers on the machine is indicated in the drawing at *E*. In order to provide room enough for the bracket, a special lever was made like that shown, to take the place of the regular lever on the machine.

Referring to Fig. 26, the construction of the overhead-piloted turning tool is plainly shown. An outline of the chuck, chuck jaws, and the work *A*, is shown on the same drawing with the turning tools in order to avoid the possibility

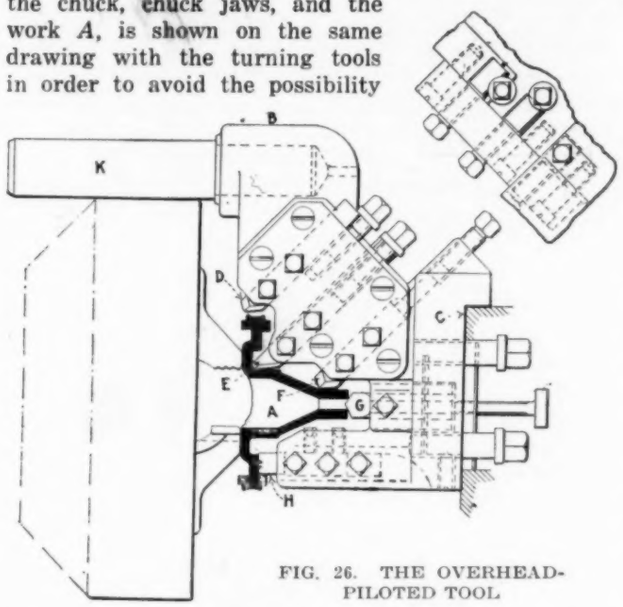


FIG. 26. THE OVERHEAD-PILOTED TOOL

of interferences between the tools and the chuck. The body of the turning tool *B* is of cast iron and is fitted to the face of the turret at *C*, being held in position by four screws from the inside of the hollow turret. The various tools *D*, *E*, and *F* are respectively used for turning the outside diameter of the gear; turning the 1.999-in. diameter and the small hub 0.8745 in. in diameter. These tools are all provided with adjusting screws by means of which they may be adjusted to a special gage (not shown) which is arranged so that it fits into the central bushing when the spotting drill *G* is removed. This gage allows the operator to set his tools to it and assures him of their accuracy without it being necessary to "cut and try" several times before obtaining the exact diameters. The spotting drill *G* spots the end of the work, and the tool *H* cuts out the pocket or shoulder as indicated. It will be seen that the latter tool also is provided with means for adjustment so as to preserve the diameter of the recess.

As all of the turning tools are set vertically, and as the pilot bar *K* enters a bushing held in the pilot bracket on the headstock, it is evident that every provision has been made to insure accuracy in the product. Tools of this kind can be used for accurate turret lathe work and tend to make the machine a precision machine. It is remarkable how closely work of this kind can be held when properly tooled, even under the necessities

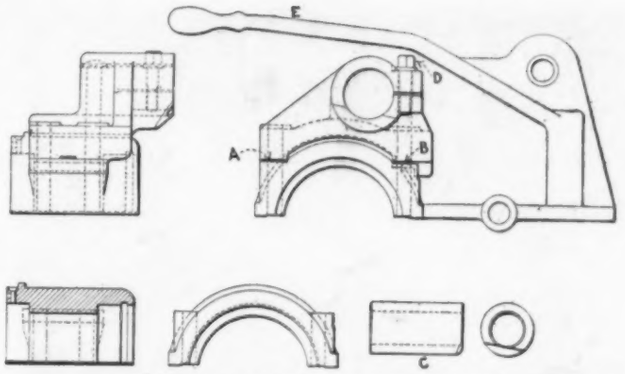


FIG. 27. PILOT BRACKET FOR OVERHEAD TURNING TOOL

of high production. This work is now being produced at the rate of one piece in seven minutes.

The other operations on this piece in the turret-lathe setting are the drilling of the hole with a twist drill in the regular tool holder, and the tapping of the hole with a tap held in a friction-tap holder. A reference to the turret-tool layout gives a very good general idea of the sequence of tools for the operations described.

Fixture for Straddle-Milling the Pintle

Owing to a difference in handling, two methods were used for straddle-milling the segment end. One of these is shown by Fig. 28. The work is located by its diameter and face in the nest shown at *B*, and is clamped in position by means of the threaded end of the screw *C*, operated by the handwheel *D* and trued up with an ordinary try-square working from the finished surface *E*. Two of these fixtures are used, one at each end of the milling-machine table. This allows the operator to be placing work in one, while the milling cutters are operating on a piece at the opposite end as shown in Fig. 29.

At *E*, Fig. 28, is shown a set block which is used in conjunction with this fixture. This block is clamped to the milling-machine table, using the T-slot which locates the fixtures. The cutters are adjusted by using feelers between the block and the cutter blades.

The Alternative Design of Milling Fixture for Standard-Milling the Pintle

Referring to Fig. 30, a high-production fixture is here shown for straddle-milling the pintle. In one case the hole in the end of the pintle was tapped in the

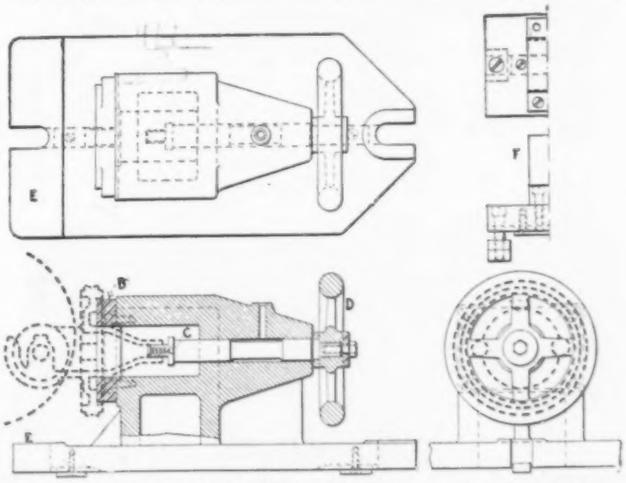


FIG. 28. DETAILS OF STRADDLE-MILLING FIXTURES

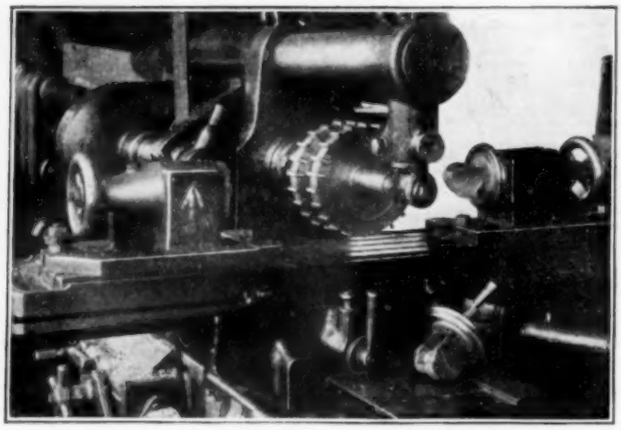


FIG. 29. HOW THE FIXTURES ARE USED

first operation, and this permitted a draw-back arrangement to be used in the fixture for milling, as illustrated in Fig. 28. In the other case, the hole was not tapped in the first operation, and this necessitated a somewhat different type of fixture. Furthermore, the design of this fixture was for very high production, whereas the other one did not require so great a production and was therefore made up in a somewhat cheaper form. Referring to Figs. 31 and 32, the machine set-up is shown on a heavy-type milling machine. A description of the tool follows:

The work *A*, Fig. 30, is placed in position in the hardened-steel nest *B*. This nest is mounted in a cast-iron ram *C*, which is operated by means of the hand lever *D*. In loading, the work is located in relation to the surfaces which are to be milled by means of the spring pin *E*, which enters a cored hole in the flange of the work. After loading the work into the ram with the latter in a withdrawn position, the lever is brought forward until the face of the gear makes against the hardened-steel locating pads at *F* and *G*. It will be seen that the latch on the lever is so arranged as to keep the ram pushed forward firmly at all times, as shown at *H*. A sector *K* is attached to the lever and acts against the steel rack *L* on the rear end of the ram.

In order that there may be no possibility of chatter in the work and that it shall be well supported under the pressure of the cut, the spring plunger *M* is dropped into position on the boss indicated and afterward locked by means of the knob *N*. At the same time, two equalizing jacks at *O* and *P* are allowed to spring up and support the underside of the work. An equalizing clamp is operated by means of the knob *Q*. The action of this clamp is to draw together the two shoes at *R* and *S* and in that way lock the jacks securely. It will be seen that the milling cutters for straddle-milling, as indicated by the dotted lines at *T*, run in very close to the fixtures, and it was therefore necessary to make the jacking arrangement on this end of the fixture very compact, in order to avoid interferences with the cutters.

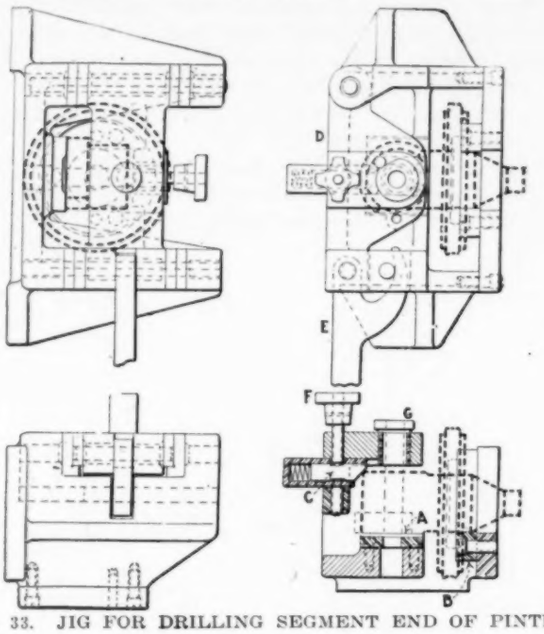


FIG. 33. JIG FOR DRILLING SEGMENT END OF PINTLE

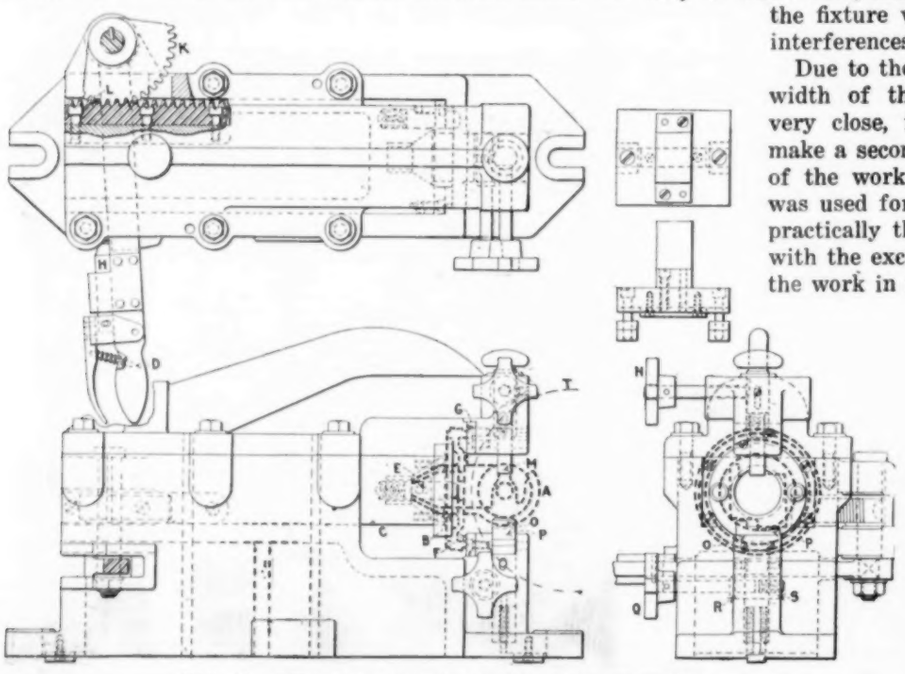
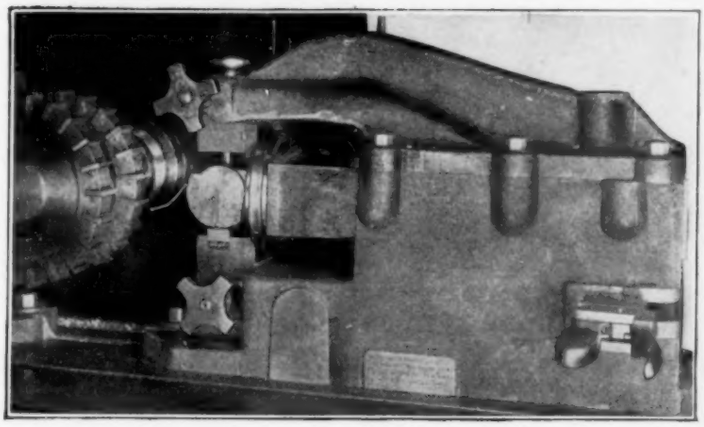
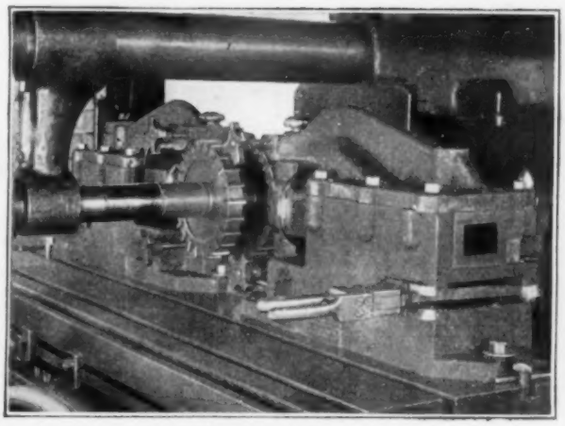


FIG. 30. DETAILS OF THE ALTERNATE FIXTURES

Due to the fact that the tolerances on the width of the portion straddle-milled were very close, it was considered necessary to make a second operation of milling this part of the work, and therefore another fixture was used for this operation. The fixture is practically the same, as that just described, with the exception of the method of locating the work in relation to the previously milled surfaces. For finish-milling, a swinging arm is arranged so that it can be swung into position against the finished side of the work, and as this is done before the clamps are tightened, it serves to straighten out the work, from the previously milled sides. The drilling and reaming the $\frac{3}{4}$-in. hole through the segment end of the pintle is done in the drill jig shown in Fig. 33. This is a leaf jig of very heavy and rigid construction.





FIGS. 31 AND 32. THE ALTERNATE FIXTURES IN USE

The work is located on a flat plate *A*, and in the nest *B*. In this latter it bears on both diameters of the pintle stem and also on the face of flange. Clamping is done by means of a powerful spring plunger *C* which is carried by the swinging leaf *D*, this leaf being clamped by the cam *E*, after the leaf has been locked; spring plunger *C* is also locked for security by the screw *F*.

After the work is in place, drilling and reaming is done through the slip bushing *G*.

Fixture for Milling Ratchet Teeth on Segment End of Pintle

The milling of the ratchet teeth on the segment end of the pintle requires a very rigid and substantial fixture as the cut is very broad. As the cutter is of the formed type, it presents all of its cutting teeth at one time and in such a way as to cause chatter if there is any chance for it to develop. This fixture, shown in Figs. 34 and 35, consists of a heavy cast-iron base *A*, which carries the cradle *B* by means of bearings at each end. The work is located in this cradle on the hardened stud *C* against the face *D*, which is also hardened. It is clamped in position by means of a screw *E* which carries a clamping washer *F* and is operated by the knob *G*. This screw passes through the center of the bearing which is a part of the cradle. The stem end of the pintle is located on the hardened plate *H* and is held securely by the clamp *J*.

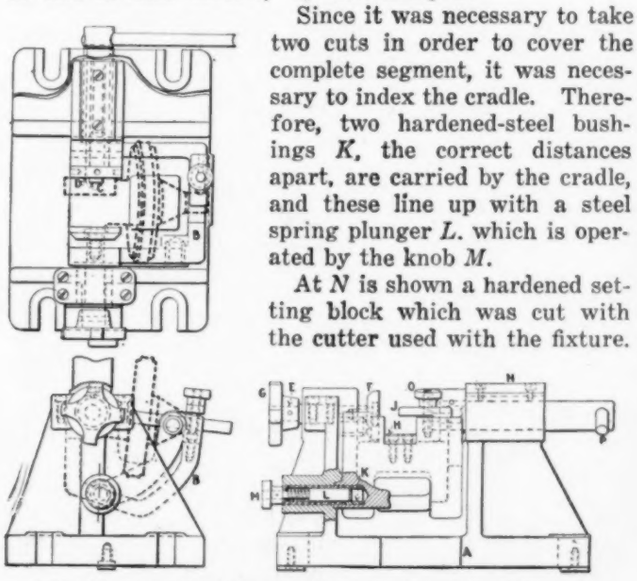


FIG. 34. DETAILS OF FIXTURE FOR MILLING THE RATCHET TEETH

Since it was necessary to take two cuts in order to cover the complete segment, it was necessary to index the cradle. Therefore, two hardened-steel bushings *K*, the correct distances apart, are carried by the cradle, and these line up with a steel spring plunger *L*. which is operated by the knob *M*.

At *N* is shown a hardened setting block which was cut with the cutter used with the fixture. This block is a permanent part of the fixture and is used for setting the cutters to correct position after each regrinding.

In operation, the work is first placed in the cradle over the locating stud *C*, the opposite end or stem end resting on the locating plate *H*. Then the clamps *F* and *J* are tightened by means of the knobs *G* and *O*. With the cradle in either one of the two positions as determined by the indexing pin *L*, and locating bushings *K*, the cut is started. After one cut is finished, the cradle *B* is swung to the second position.

Jig for Drilling the 0.2460-In. Diameter Hole

The drilling of the 0.2460-in. hole was done on the very simple jig shown in Fig. 36. This consists of a cast-iron base *A*, locating stud *B*, and the clamping arrangement *C*.

The jig is clamped permanently to the drilling-machine table. In operation the work is slipped over the central locating stud *B*, while the stem end rests on a finished pad *D*, and is clamped in position by means of the clamp *C*, operated by the handle *E*. This is a quick-operating arrangement as the work is held securely

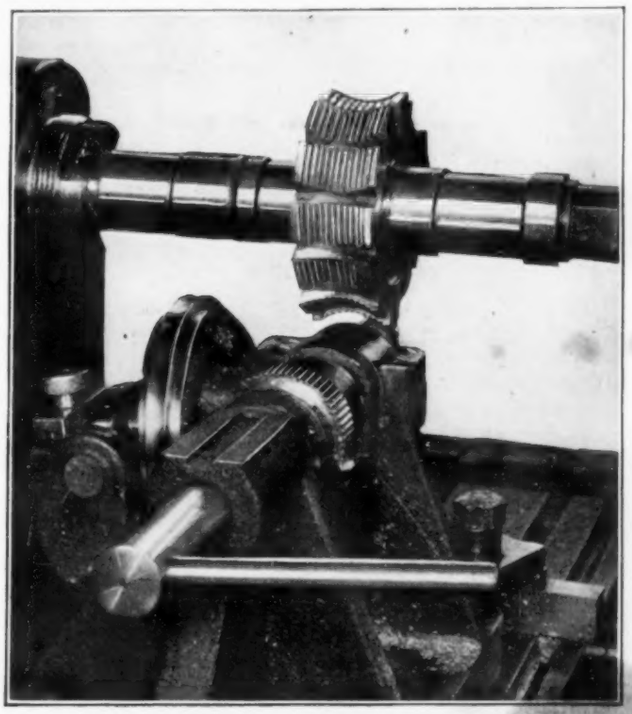


FIG. 35. MILLING THE RATCHET TEETH

by means of the spring plunger *F* which bears against a beveled surface on the clamp *C* and while it holds securely, it is readily released by a quick movement of the handle *E*.

As will be noted, a slip bushing is used in order to get close down to the hub, it being necessary to remove this bushing, in order to get the work into and out of the jig.

Fig. 37 shows another very simple, convenient and quick-acting jig which consists of a heavy cast-iron base *A* on top of which is mounted a locating nest *B*. This base is permanently bolted to the drilling-machine table. To the quill of the drilling machine *C* is attached the piece *D*, through which

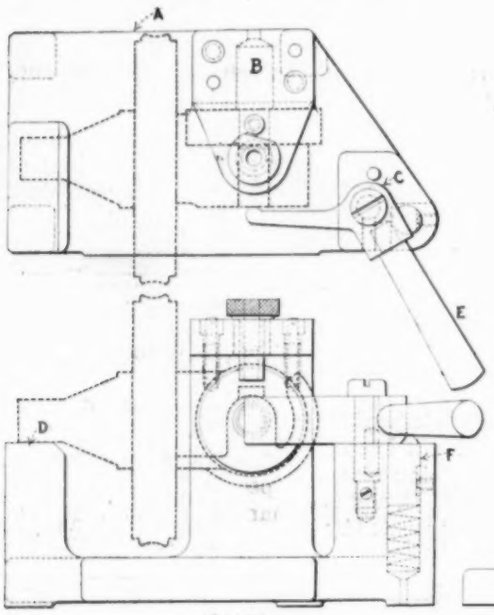


FIG. 36

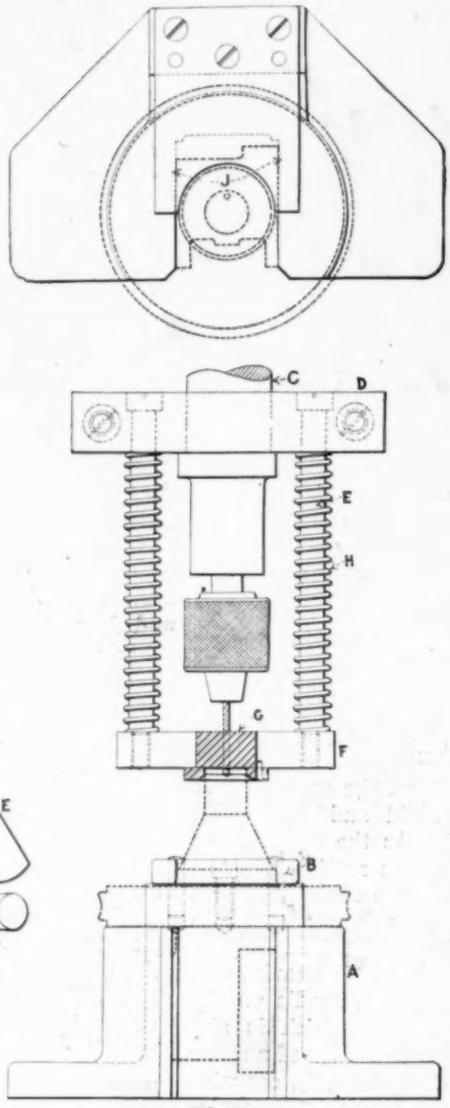


FIG. 37

FIGS. 36 AND 37. A PAIR OF DRILL JIGS

Fig. 36—Jig for drilling the 0.2460-in. hole. Fig. 37—Jig for drilling the 0.128-in. hole

slide two shoulder screws *E* that carry on their lower ends the plate *F;* this, in turn, carries a combined drill bushing and locating nest *G*, the plate being held down by the pressure of the springs *H*.

In operation, the work is placed on the base *A*, resting on its face and up against the locating nest *B* being prevented from turning by the two faces *J*. As the drill spindle is brought down, the locating nest and drill bushing *G* are forced down over the stem end of the pintle, locating it accurately. The continued downward movement of the spindle feeds the drill into the work, completing the operation.

The principal feature which commends this jig is the fact that there are no clamps, leaves or latches of any kind, and the work can be placed in or taken out of the jig instantly.

Graduating is done in a simple type of press die shown by Fig. 38. This die consists of the cast-iron base *A*, and a top member *B*, which is held in position and guided by the two pieces *C* which are a fit in the base *A*. Base *A* carries the die *D*, which has engraved on its top surface both the figures and graduations required to be stamped on the pintle. The pintle is located first by the large diameter of the stem which fits inside diameter of the die as shown, and second, by the two surfaces of the segment end, being held in correct position by the finished surfaces *E* of the top member. The distances *X* were made in such a way as to make the die fool-proof, as the pintle could only be located in one position.

The wormwheel was hobbed on a Shuchardt & Schutte gear-hobbing machine for which the fixture shown, Fig. 39, was designed. This fixture consists of a base *A* made of cast iron, on top of which is a hardened nest *B* which locates the work central by the large outside diameter of the neck, and for height, by the face of the flange on which the worm is to be cut. The means of clamping the work consists of the stud *C*, which is shouldered at one end and threaded at the other to fit into the ½-in. tapped hole in the stem end of the pintle. This stud is a slip fit through the long hub of the bevel gear *D* and is keyed to this gear so that the gear acts as a driver. At the outer end of the gear hub is a locknut *E* and a keyed washer *F* which hold in position the ball-thrust bearing *G*. A light spring *H* serves to keep the stud *C* in position. In the bottom of the fixture is the plate *J* which is turned and bored true with the locating nest on top, so that the fixture can be easily and accurately located on the machine by placing it over the locating stud *M*, which is driven into the center of the table spindle.

In operation, the work is first dropped into the locating nest *B* and down onto the stud *C*, the spring allow-

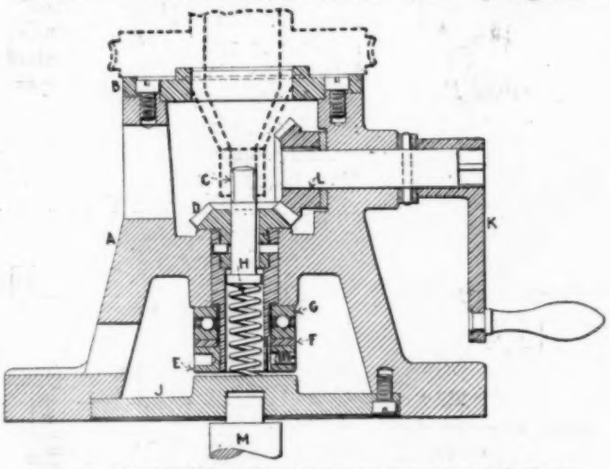


FIG. 39. FIXTURE FOR HOBBING THE WORM GEAR

ing the stud to push down by the weight of the pintle. Then the crank *K* is turned and the bevel gear *D* is operated by means of the bevel gear *L*. By this means the stud *C* is screwed into the end of the pintle and

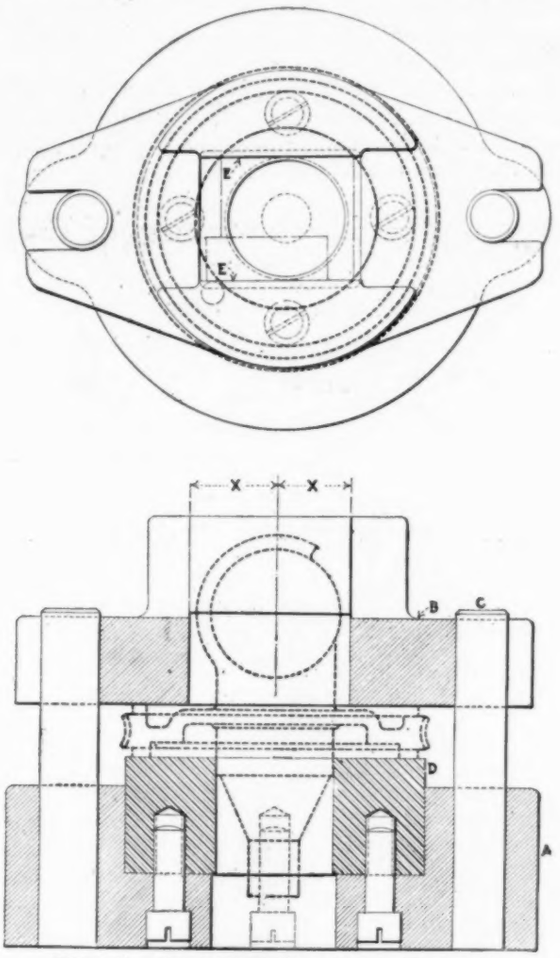


FIG. 38. GRADUATING PUNCH AND DIE

thus the pintle is drawn down and held securely on the locating nest, after which the machine is started and the work of hobbing the gear may be accomplished. The output of this fixture was 12 finished gears per hour.

Setting Diamonds for Wheel Dressing

By G. E. Woodley

As I have never seen anything in the technical papers upon the subject of diamonds for wheel dressing I feel certain that your readers who may be having the same trouble we have had will be interested in the following:

Up to about two years ago, when it became almost impossible to buy diamonds, our method of setting was to have an experienced toolmaker peen them into place in copper, or else return them to our supplier for resetting.

Both these methods have their disadvantages. In peening, many diamonds are broken or cracked, and when a diamond is so fractured it seldom lasts any length of time. Returning them to the supplier makes it necessary to carry about 50 per cent. more diamonds than is actually required to do the work; besides, if the diamond people care to, they can remount and return any old diamond, no one being any the wiser, as only a small part of the diamond projects from the mounting. The average concern has anywhere from $1000 to $2000 worth of diamonds on hand, and when this investment is increased one-half by having diamonds continuously in transit for resetting the loss is worth considering.

We have worked out the following method, and have as good if not better results than when we returned them for resetting. Each new diamond is very carefully weighed in our chemical laboratory before the first setting as a check against the purchasing weight. The diamond is then given a number, which with its weight is recorded on the diamond record sheet. It is very carefully examined with a magnifying glass for what we call cleavage grains and after this is determined, and the proper edge or corner to use is decided upon, it is fastened into a small cage made from $\frac{3}{16}$-in. annealed wire as shown in Fig. 1, care being taken in

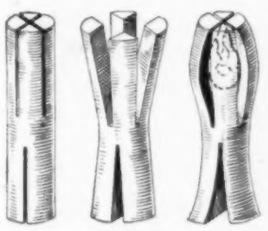


FIG. 1

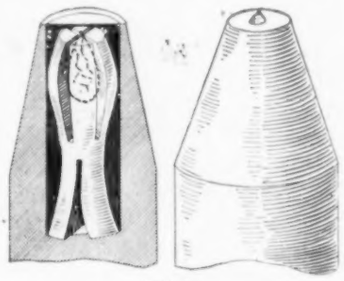


FIG. 2

FIGS. 1 AND 2. CAGE FOR HOLDING DIAMOND AND METHOD OF MOUNTING

locating the corner that was selected and that all cleavage grains are at right angles to the face of the wheel.

This is important, as a diamond set with the cleavage grain parallel to the face of the wheel often misleads people to think that it is soft.

Note that the $\frac{3}{16}$-in. wire is split with a hacksaw into quarters on the end where the prongs are to be fastened about the diamond, while the other end is split one way and opened slightly with a chisel or screwdriver, to give a spring tension on the sides of the hole in the diamond holder. This helps hold the diamond in place, but is needed more to keep the diamond and cage from floating in the molten metal while setting. The diamond is properly set in the cage, care being taken that the point of the diamond is at least $\frac{1}{8}$ in. below the edge of the holder. The reason for this is that we use an oxy-acetylene welding torch, and we are very particular that the flame never touches the diamond. Some diamond people claim that fire won't hurt diamonds, but my advice is to keep the flame away from them as much as possible. The holder is then gripped in a vise and the torch brought into action. We begin heating the holder about one inch down from the end, allowing the heat gradually to work up to the top.

When the end of the holder, diamond and all, have been properly heated to about 1100 or 1200 deg. the operator melts cast-iron welding rod into the opening in the end of the holder. Any good welding flux may be used. This may seem difficult to do but anyone experienced in oxy-acetylene welding can accomplish it with a little practice. The time required for this operation is approximately three minutes. The diamond after setting is shown in Fig. 2.

We have obtained best results from cast-iron welding rod. I have used copper and brass to some extent, have tried brazing in open gas fire, also in charcoal fire,

using regular brazing spelter and also pure copper and brass. I have experimented with silver, hard tin, hard white metal and soft steel, but none of these give as good results as cast iron.

Diamonds Do Not Come Lose Or Break

I have never known a diamond to come loose or to be lost since we have adopted this method. We do not have one-tenth the amount of diamonds broken that we had when the peening method was used, and we are not holding up production as heretofore, because of diamonds coming loose in the mounting, thereby obliging the operator to wait until another one could be obtained or the loose one reset. Our average diamond cost per dressing on wheels from 14 to 24 in. in diameter, with a face width of from 1½ to 6 in. does not exceed eight cents. On smaller wheels, such as tool-grinding, internals, etc., the cost does not exceed three cents. We have one man in our plant who does all the wheel dressing on large wheels. This man keeps a very accurate record on the diamond record sheet which is turned into my office each day and placed on permanent record.

In setting diamonds the holder should never be plunged into water after the welding operation, as this sudden cooling will cause the diamond to check. After the holder is cooled so that it can be handled, the end that contains the diamond is ground off by hand until the diamond touches the wheel, which can readily be observed by the emery dust. An angle of approximately 60 deg. is then turned or ground by hand, and the diamond is ready for service.

Time Required to Set Diamonds

I have given considerable study to the time required for setting diamonds by this method. The holders are made in lots of 25 from standard cold-rolled steel. No turning is required, simply drill a $\frac{3}{16}$-in. hole in the end. The time required for making holders is approxiamtely 8 min.; for inspecting, weighing, and fastening diamond into cage, 12 min.; removing diamond from old mounting, 5 min.; welding, 6 min. (this includes preheating); grinding end and forming angle, 10 min. I have gone to the extreme in this time estimate which is 41 minutes.

Diamond men have told me that I can not set diamonds as cheaply as they can; they charge 75 cents per setting; our overhead is 100 per cent. in the department where this work is done, thus there is but a slight difference in the cost and our diamonds are always in our plant ready for use.

When the diamond is removed from the mounting for resetting, which is done after it develops a flat face not to exceed $\frac{3}{16}$ in., a hacksaw is used to cut five or six slots along the side of the diamond, loosening it so that it is easily removed. Extreme care must be used as a shock or blow from a hacksaw, chisel or other tool will do more damage than the most severe usage.

The diamonds are weighed each time after they are removed from the mounting, and the number and weight stamped on the holder. We do not reset diamonds for large wheels after they have been worn down to ½ or ¾ carat, but mount them for Heald internal, or tool-grinding machines.

This method may be crude to people that make diamond setting a business, but they do not seem to be giving out any information on the subject. I have asked several diamond men how their firm set stones, but they always change the subject just before reaching the explanation. If any other readers of *American Machinist* have anything to offer along this line I would be glad to hear from them, for I know that my employees would willingly have paid for information of this kind two years ago.

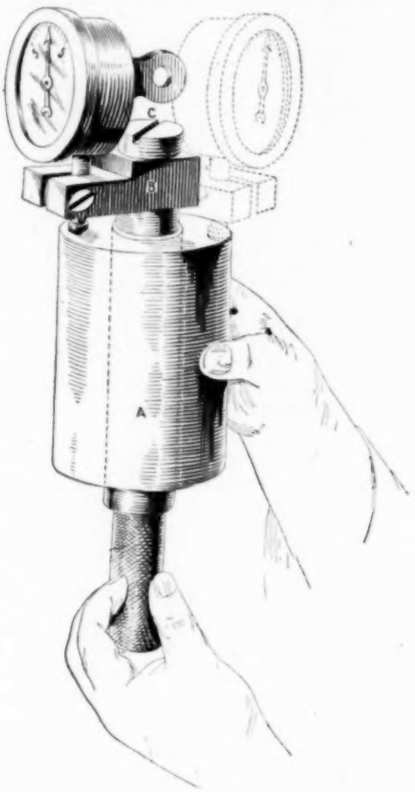
Please bear in mind that diamonds are one of the most necessary, expensive and abused tools of any shop equipment. This method eliminates about 50 per cent. of the expense and trouble.

Gage for Testing Squareness of End of Bearing

By C. H. Dengler

There is a bronze bearing in the Hispano-Suiza airplane motor, the face of which must be accurately square with the bearing, and to test this relationship the gage herewith illustrated and described was made; a standard dial plug of well-known make being used for the purpose.

A plug is made a push-fit in the bearing *A* and the bracket *B* turns on a shoulder at the end of the plug,



GAGE FOR TESTING TRUTH OF BEARING FACE

being held thereto by the screw *C*. The bracket carries the dial gage with its contact button extending parallel to the plug.

Pushing the plug into the bearing until the button bears upon the face to be gaged, the bearing is slowly rotated by means of the knurled extension of the plug while the bracket and indicator are held against movement.

This causes the contact button to sweep over the face of the bearing and any departure from truth will be instantly detected.

Applying Army Methods of Selecting Men for Industry

By P. N. GOLDEN
Trade Test Division, War Department

The experience of the Army indicates that we can prevent much lost motion and expense by sorting out applicants for employment before they get into the shop. The tests used gave remarkably accurate results and seem to offer the basis for a solution of some of our employment problems. They are well worth careful consideration.

THE methods used in selecting men to fill specific jobs vary, in industry, from the personal "hunch" to a thorough, lengthy and expensive preliminary tryout. It is recognized that a large percentage of the labor turnover is due to placing the wrong man on the job. By the "wrong man" is meant a man having a lack of skill, or the wrong kind of skill. When you come to analyze many of the causes of labor turnover, not generally considered due to lack of skill, you will find it plays a greater or less part in many of them. A common example of a case of this kind is the man who "can't get along with his foreman or fellow employees." His trouble is often due to his efforts to cover up his own shortcomings by continual arguments with and criticisms of his fellow employees.

Many do not stop to consider that the cost per man per turnover varies from a very few dollars to $200 or more, with an average probably somewhere in the vicinity of $30. On this basis a labor turnover of only 2 per cent. per week on a total number of wage earners of about 40,000,000, means an annual loss of over a billion dollars; any practical method of decreasing this dead loss is worthy of very careful consideration.

Where regular employment offices are maintained in an industry, their chief function is to bring an applicant who claims a certain degree of skill into contact with an opportunity to demonstrate, at the employer's expense, whether he really has the skill claimed, or only thinks he has. When an applicant enters an employment office, the usual predecure is to interview him as to his family history and the kind of work he wants, and then turn him over to a foreman or department head whose job it is to find out what he can do. Very little effort is made to determine an applicant's ability *in* the employment office *by* the office personnel.

When the United States tackled the problem of organizing an army of 4,000,000 men in a hurry, it *had* to find another method, for there were not enough foremen or department heads available in the country to do the job of trying out the men, without absolutely crippling industry.

The Committee on Classification of Personnel in the Army was organized to solve the problem and it did so with a degree of success which exceeded even its own hopes and anticipations. Several methods were used in selecting men for the various duties connected with the Army, the method most applicable to industry being the trade test. These trade tests were of three classes: oral, picture and performance. A trade test was devised for each specific trade. In attacking the problem the Trade Test Division of the Committee made the assumption that the time to find out whether a man would fit the job was before he was put to work and not after he had demonstrated at an expense of time and money that he would or would not fit.

Actual "Tryout" Seldom Necessary

One of the things the Committee did was to shoot the bug-a-boo of "the only way to find out is to let the man show what he can do" so full of holes that it can be considered practically dead. There are a few occupations to which the above rule applies, but their number is so small that they can be considered almost negligible. Another secret of the Committee's success lay in that they refused to believe that "what a man *knows* is no indication of his ability to hold a job" and they proved their idea was correct in innumerable cases and under many trying conditions.

Looking at the results of the solution of the problem of making oral and picture trade tests, it seems as though the problem was simplicity itself. In reality, however, the Trade Test Division of the Committee did a vast amount of experimenting before it got hold of the basic principles involved and was able to turn out tests that were fair to the man, fair to the Army, and that really showed the degree of a man's ability by the answers he gave to the questions asked. Thousands of questions were gathered and tried out in various forms before the final sets were ready to be standardized, preliminary to choosing the specific questions which would give the desired results.

The main reason the oral trade tests gave such satisfactory results was because the questions asked were such that the tradesman actually knew the answer, not what he should theoretically know. The answers printed in the test were correct answers which the tradesmen themselves actually gave, not answers given in handbooks, schoolbooks, or by some technically trained manager or engineer. The questions, moreover, were so carefully worded that their meaning was perfectly clear and the answers printed in the tests were, so far as it was humanly possible to discover, the only correct answers which would be given by tradesmen. The result was that men could be rated by these tests by anybody who could read and put down the scores made in conformity with a set of very simple rules.

Using Pictures in Making Tests

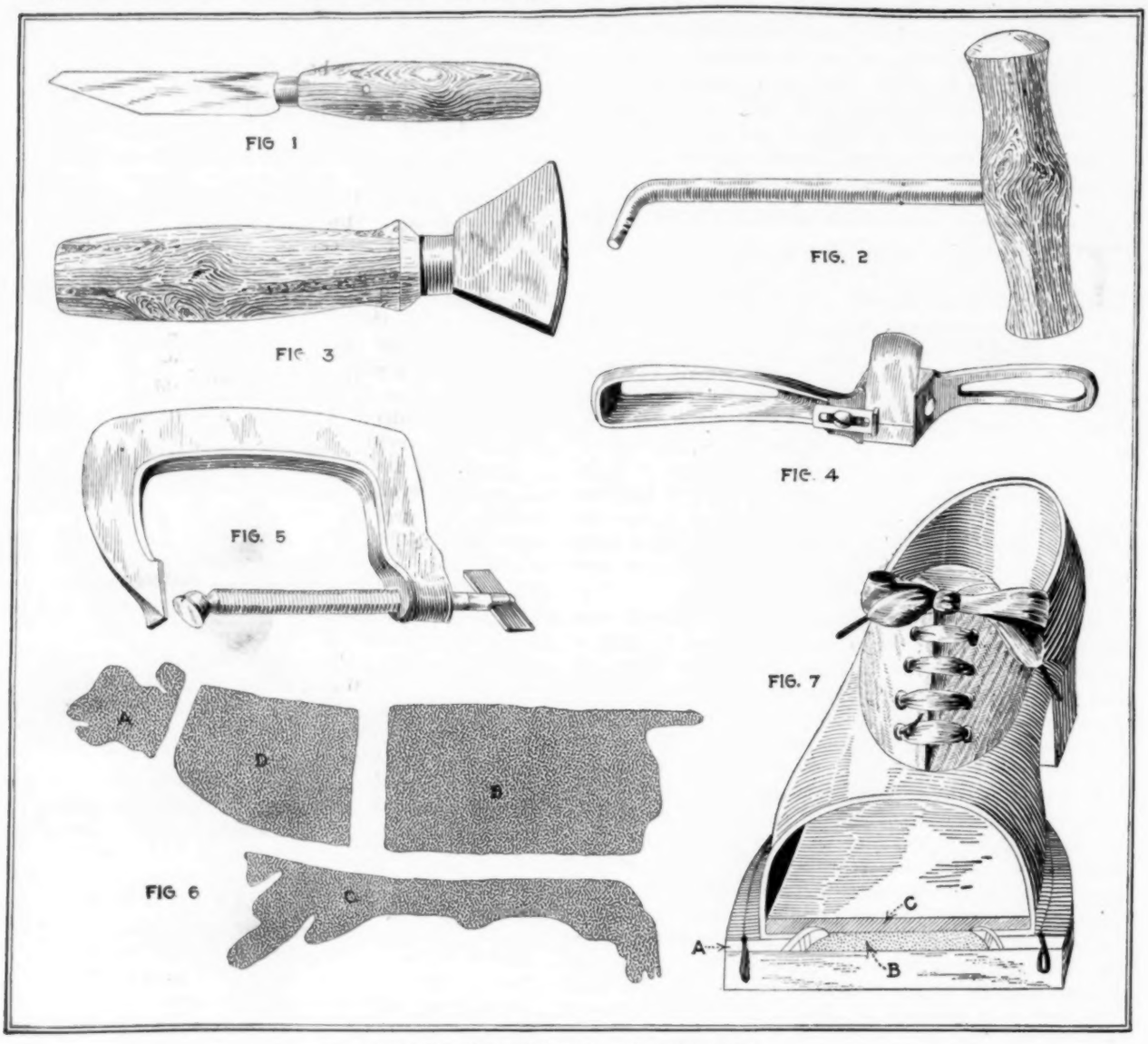
The Trade Test Division early discovered that something more than a straight oral test would be of value, so picture trade tests were devised and used as an additional check on the results of the oral tests. These picture tests allowed a number of questions to be asked that were impossible without the aid of pictures and so increased the range and number of questions in many trades.

Performance trade tests were also devised, but the

difficulty of standardizing them, their limited range and the administrative expense being so great, that the question of discontinuing them, except for a certain very limited number of occupations, was under serious consideration. The great success obtained by the oral and picture trade tests made the additional slight and questionable value gained by a performance test unwarranted. It clearly demonstrated that in practically all occupations an oral test would rate an individual's ability in his trade fully as well as a tryout, with a mere fraction of the expense of time and money.

A properly devised oral trade test can be administered by any man or woman of ordinary intelligence in an employment office in less than 10 minutes, and the applicant will in at least 90 per cent. of the cases show, on being put on the job, the degree of ability indicated by the result of his oral trade test. This was proved repeatedly by going to a shop and having the foreman make a list of 10 of his men in the order of their ability. The men were then given the test, rated by it and the lists compared. The variations between the two lists were so slight as to be neglible, and in many cases the foreman, on a careful study of the two lists, agreed that the oral-trade-test list was a really more accurate rating than the one he had prepared.

One examiner who tried out questions on over 500 tradesmen found only *one* man whose oral trade test rating was enough off, compared to his employer's knowledge of his ability, to have made it necessary for the employer to have dispensed with his services if he had hired him on the basis of an oral trade test. In general, the tendency was for a man to rate very closely to the employer's opinion of his ability, and the few cases where the rating did not closely check were generally due to either slight language difficulty, or unusually superior or inferior education on the part of the man examined.



TRADE TEST PICTURES FOR COBBLERS

Of course no general set of questions can be made up which can be published and furnished to employers. In the first place they would soon become common property and therefore valueless, and in the second place, much better results would be obtained by employers making up their own trade questions, which will more closely follow the degree of skill needed by their particular class of work than a general set of questions could do.

It has been shown by the Trade Test Division's ex-

perience that a man of the right caliber can be trained in the art of making trade tests in a comparatively short time. Such a man can make up tests, standardize them on the concern's own employees and furnish the employment office with a means of quickly, accurately and inexpensively classifying all applicants before they are passed through the employment office.

The objection may be raised that knowledge of the questions asked by any specific concern will soon become common property. The answer to this objection is that more than one set of questions must be made up for each trade. By making, for example, two sets of questions, and then additional combinations from these sets, the coaching probability is tremendously reduced. Questions which do not apply *only* to the trade covered can also be used and their score disregarded in rating the man, and in this way the difficulty of coaching increased.

ORAL TRADE TEST—MACHINIST—
ENGINE LATHE OPERATOR

1 Q.—What do you call the lathe center which turns when the belt turns?
A.—Live.
2 Q.—When work is held between centers, what is clamped on its live center end to turn it?
A.—Dog.
3 Q.—What is the smallest graduation on an ordinary machinist's scale.
A.—1/64 (1/100).
4 Q.—What tool is used to set the thread tool square with lathe center?
A.—Center-gage.
5 Q.—What do you call the feed which is used when facing off a large flat disk?
A.—Cross.
6 Q.—What do you call a chuck where all the jaws move together?
A.—Universal.
7 Q.—On what metal do you use a turning tool without any rake?
A.—Brass.
8 Q.—What is the pitch of a single thread screw which has a lead of ¼ in.
A.—¼; sometimes called 8 pitch.
9 Q.—In turning a taper on a rod 1 ft. long, how far would you set the tailstock over for a taper of ¼ in. per foot?
A.—¼.
10 Q.—What is the name of the standard taper of approximately ⅝ in. per foot?
A.—Morse.

PICTURE TRADE TEST—COBBLER

Picture No. 1
1 Q.—on what part of a shoe do you use this knife?
A.—Uppers.
Picture No. 2
2 Q.—What kind of a hook do you call this?
A.—Last.
Picture No. 3
3 Q.—What kind of an iron is this?
A.—Burnishing.
Picture No. 4
4 Q.—What do you call this tool?
A.—Shave (trimmer).
Picture No. 5
5 Q.—On what part of the shoe do you use this tool?
A.—Heels.
Picture No. 6
6 Q.—What parts of the shoe do you get from the parts of this side of leather marked *A* and *C*?
A.—(*A*) Heels.
(*C*) Insoles.
7 Q.—From what part do you get prime soles?
A.—*B*.
Picture No. 7
8 Q.—What do you call the part of the shoe marked *A*?
A.—Welt.
9 Q.—What do you call the part marked *B*?
A.—Filling.
10 Q.—What do you call the part marked *C*?
A.—Insole.

Experience has also shown, that with the degree of intelligence generally possessed by the average employee, if the trade questions are asked him before the necessary personal questions, he will be unable to remember more than a very small percentage of the trade questions; and even if he does remember them, he has no idea, in many cases, whether his answers were right or wrong.

The U. S. Department of Labor was quick to see the advantage in using the trade-test method of determining a man's ability in connection with the U. S. Employment Service. In order to apply this method, the department opened a new office at 1184 Broadway, New York, for placing skilled mechanics. A modification of the Army trade tests have been in use in this office since the first of the year and the results obtained have been very gratifying.

By being able to refer only men who have the trade ability they claim to employers, the employer is saved the time and expense of interviewing and trying out applicants who have no possibilities. The prospective employee is also saved the time and money which he would lose by being referred to openings for which he really is not qualified, and has no possibility of being able to fill.

A list of questions used in an oral test for machine work is appended to give some idea of the method and to suggest how such questions may be prepared by the employment manager. A picture test is also shown, but in order to avoid all interference with those which might be devised for machine-shop use, a test used for cobblers is given instead. This shows how the tests are arranged and will serve as a guide for other trades.

A Renewable Broach

BY S. R. DODGE

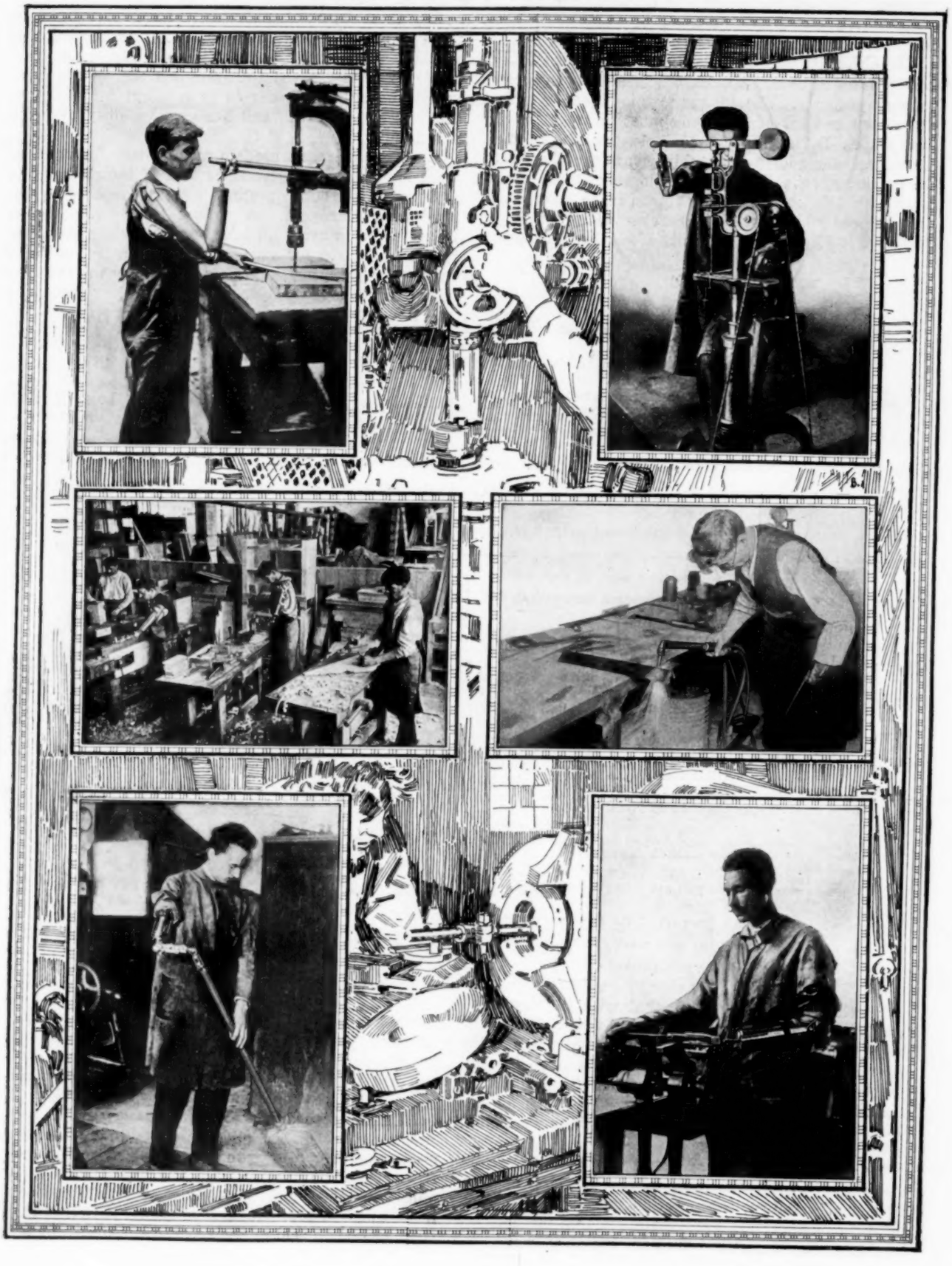
Where a perfectly smooth, straight hole of great accuracy is required, one of the surest methods of securing it is by means of broaching. Inasmuch as a broach is a fairly expensive tool, some means should

A BUILT-UP BROACH

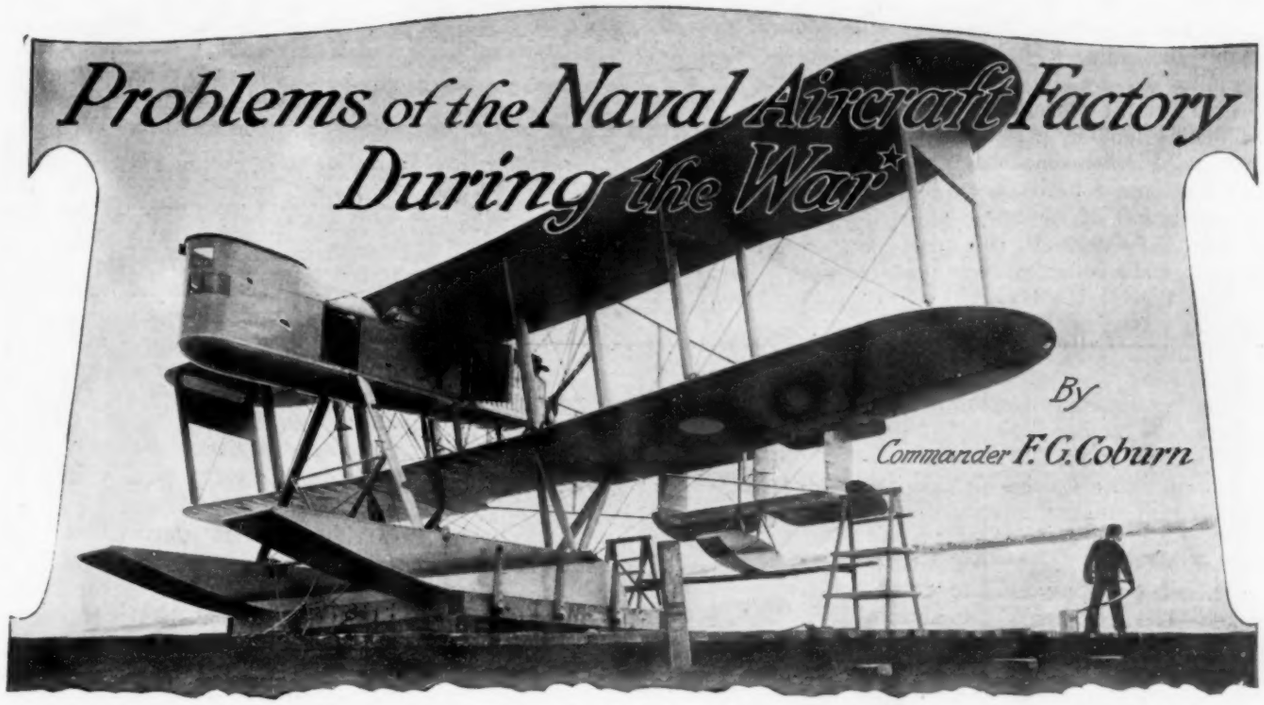
be taken of keeping the vital teeth (which are the last few) up to size without sacrificing the entire broach, as is customary now.

The sketch shows how the end teeth may be replaced when they are worn undersize through service. The hole in the separate teeth should be ground to a snug fit on the broach end and the outside diameter should be ground after the teeth are assembled on the broach. A nut may be used to keep the teeth firmly against each other. I would not recommend this method for sizes under 1.500. In shapes other than round, the teeth should be held in their relative positions by a key.

USING MECHANICAL HANDS IN THE SHOP



Problems of the Naval Aircraft Factory During the War*



By Commander F. G. Coburn

Much less has been heard from the Navy about its aircraft program and the degree of fulfillment attained than from the Army with its many flying fields, thousands of fliers and large enlisted personnel. So much was expected of the Army scheme and so many of the available facilities devoted to it that the Naval Aircraft Factory was considered a necessity not only as an experimental laboratory but as a producing plant.

THE reason for the establishment of the Naval Aircraft Factory was the problem of aircraft supply which faced the Navy Department on the entrance of the United States into the great world war. The Army's requirements for large numbers of planes promoted a decided lack of interest in the Navy's requirements for comparitively small numbers of machines and the Navy Department therefore concluded that it was necessary to build and put into production an aircraft factory to be owned by the Navy in order, first, to assure a part at least of its aircraft supply; second, to obtain cost data for the department's guidance in its dealings with private manufacturers; third, to have under its own control a factory capable of producing experimental work.

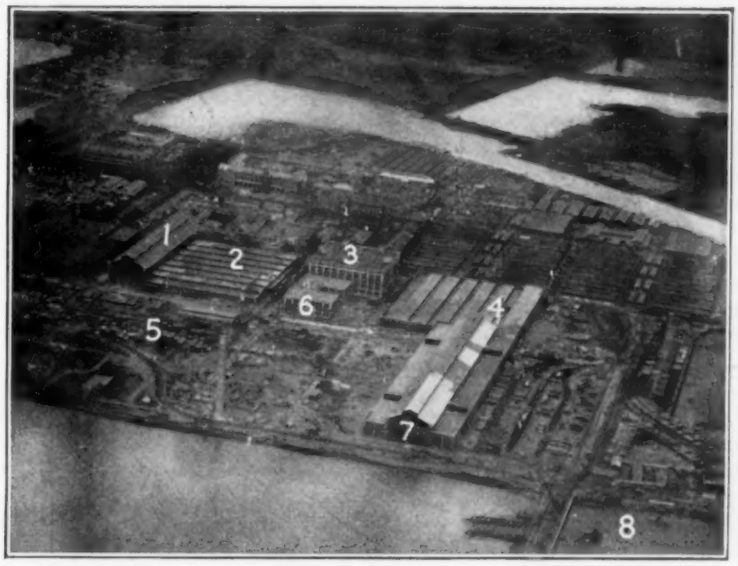


FIG. 1—AIRPLANE VIEW OF NAVAL AIRCRAFT FACTORY
(1) High shop, original plant. (2) Original mill, shops, offices and storeroom. (3) The storehouse. (4) Panel, pontoon, paint and dope rooms. (5) Lumber yard, kiln and boiler house. (6) Office building. (7) Assembly shop of the enlarged plant. (8) Hangar.

The contract was awarded Aug. 6, 1917. Beneficial occupancy of part of the building was obtained about Oct. 1, 1917. On Oct. 16, 1917, 67 days after breaking ground, the first power-driven machine was put in operation and the entire building was pronounced complete Nov. 28, 1917.

The engineering data and plans for the planes to be built were received by the factory Oct. 26, 1917, and on Mar. 27, 1918, 228 days after ground was broken and 151 days after receipt of the plans, the first machine was given its first flight, which was successful, and on Apr. 2, 1918, this machine and the second one were shipped from the factory en-route to England. These two boats were the first of the original manufacturing order, which was completed July 2, 1918, ahead of the time scheduled for its completion. The original plant consisted of a building 400 ft. square containing a balanced plane factory; that is, mill, metal shop, panel shop, covering, varnish and dope rooms, hull shop and final assembly, together with the general offices, toilet and locker rooms, cafeterias and

*From a paper presented before the Society of Automotive Engineers, Feb. 6, 1919.

storeroom. In addition there was a four-cell Tiemann dry kiln, a brick building 60 by 100 ft., heated for the storage of kiln-dried lumber, a lumber yard with modern pile bottoms for the accommodation of approximately 3,000,000 ft. of lumber, and a boiler house.

Fig. 1 gives the layout of the entire factory buildings, Nos. 1 and 2, constituting the original project, the block to the south of the main building, No. 5 being the lumber yard. The large building is made up of a section 300 x 400 ft. of the Austin company No. 3 building, and a special bay 100 x 400 ft. was added to supply hull building and final assembly space. This extra bay was 100 ft. wide with a clearance under the roof trusses of 51 ft., accommodating a 10-ton, three-motor, overhead traveling electric crane with a 40-ft. hook hoist. The provision of this high, wide, long bay seemed to many to be of doubtful value, but it was intended to meet the requirements of the future, which it seemed certain would be for large planes, and as it happened the factory never went into production on small planes, but was started at once on large planes, making this building and its crane a paying investment from the start.

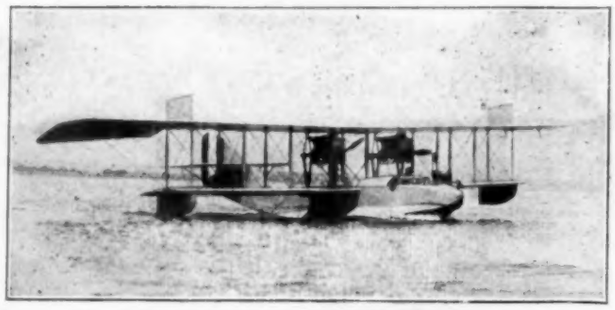


FIG. 2. H-16 FLYING BOAT

Layout Assured Flexibility

The allocation of space to the various activities of the plant was a problem which did not at the time admit of solution because of lack of definite information on the types of machine to be built and the amount of space required for known types of machines. The only partitions erected therefore were those necessary to meet the following requirements: First, to separate the high bay from the low part of the building as a fire protection measure; second, to separate the offices, toilet and locker rooms and cafeteria from the factory for fire protection, cleanliness and quiet; third, to inclose the metal shop and the varnish and dope room as a matter of fire protection.

The machinery purchased was equipped with individual motors so that no provision for line shafting was necessary and the location of the machines could be changed at pleasure.

Having noted that a watering pot was necessary to preserve the necessary humidity in airplane factories and realizing the desirability of standardized and constant atmospheric conditions as to temperature, humidity and ventilation, the Carrier system of heating, humidifying and ventilating was installed. This is the system now being commonly used in cotton mills and was introduced into an airplane factory for the first time. It has automatic temperature and humidity control, the air condition being standardized at that which would provide a good working temperature (65 deg. F.) together with a 50 per cent. humidity, which would insure that wood dried to 10 per cent. moisture content would neither absorb nor give off moisture. It was then insured that small and particularly thin wood parts would maintain their size and shape after manufacture and thus facilitate assembling. The system proved most satisfactory. Probably all plane manufacturers in the aircraft world went through the same distressing times experienced by the Naval Aircraft Factory of having to start work as winter approached in incomplete buildings without light and without heat, and without those conveniences and articles of equipment which are not appreciated by those who work in established factories.

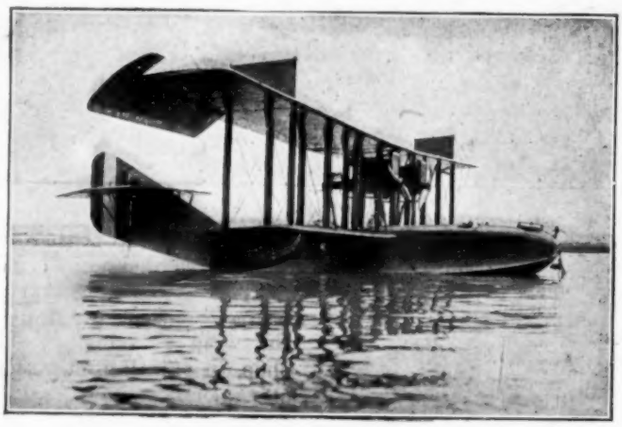


FIG. 3. F-5-L FLYING BOAT

In December, 1917, it was decided by the Navy Department to make a great increase in the aircraft building program to meet the requirements for planes for patrol and convoy work in the North Sea and particularly over the waters contiguous to the coasts of Ireland and France. Although at this time the Naval Aircraft Factory was not yet in production, its original plant was complete, the organization was formed and working, a fair start had been made on the assemblage of a working force, and it gave promise of coming satisfactorily into production. The new program necessitated the provision of additional manufacturing facilities because the Army was not prepared to release any of the facilities assigned to it by the Aircraft Board.

The first problem was to decide whether or not to construct a balanced factory to supply the needed capacity. After considerable discussion it was decided that the time required for the erection of the building, the assembling of sufficient personnel, etc., was so great as to preclude so doing. It seemed better to utilize idle plants in the industrial world for the production of parts and to erect as an enlargement of the Naval Aircraft Factory an assembling plant to be fed by these sources of parts and minor assemblies.

For this there was provided a building shown in Figs. 1 and 4, consisting of two parts—a low building 13 ft. under the roof trusses was provided for panel shop, varnish and dope room, pontoon manufacture, etc., and a bay 100 ft. wide, 51 ft. under the trusses and 680 ft. long for final assembly, flanked on each side by a bay of equal size, 50 ft. wide and 30 ft. under the trusses. The 100-ft. bay was equipped with two 10-ton, three-motor, overhead traveling electric cranes, and the side bays each with a 2½-ton small crane. The plan was to manufacture and assemble wings, pontoons and similar parts in the

low section, assembling them to jigs and packing them for shipment, the boat hulls to be put through final assembling, packed and shipped from the high bay, while the flanking bays were used for subassembling.

As sources for hulls some six yacht-building yards were obtained, and for the supply of wings, metal parts, tanks, engine foundation assemblies, tail surfaces, etc., the services of a number of plants were enlisted which might have otherwise stood idle due to the discontinuance of their peace-time business.

The direction of the entire program was reposed in the central offices of the Naval Aircraft Factory, which necessitated enlarged office space. Therefore, a concrete three-story office building was erected to accommodate the offices and the old office space was put into production. A six-story concrete storehouse, approximately 200 ft. square, was provided to meet the enlarged storage-space requirements and the storage room in the original factory was thrown into production space. The dry-kiln capacity was doubled, as was also the heated storage building and the lumber yards. The success of the Carrier heating and ventilating system in the original dictated its installation in the new assembling plant and in the heated lumber-storage building.

In the design of the buildings provision was made for sprinklers and the buildings were also supplied liberally with fire boxes, sand boxes and fire extinguishers.

Responsibility for the acquiring, developing and retaining a satisfactory personnel outside of the executive staff, was placed in an employment department under the direction of an employment superintendent. The employment superintendent is one of the five main department heads reporting to the manager. The specific functions assigned to the employment department originally included employment and training. Later, as the work developed, responsibility for a certain amount of factory follow-up and for all service work of the factory was added.

When the factory was starting it was necessary to employ men almost entirely for mechanical work. As soon as a sufficient number of men had been trained to carry the work along it was considered not only desirable and necessary to use women wherever possible, but also to use them as a war duty. The most important training work taken up by the employment department was the introduction of women into the factory.

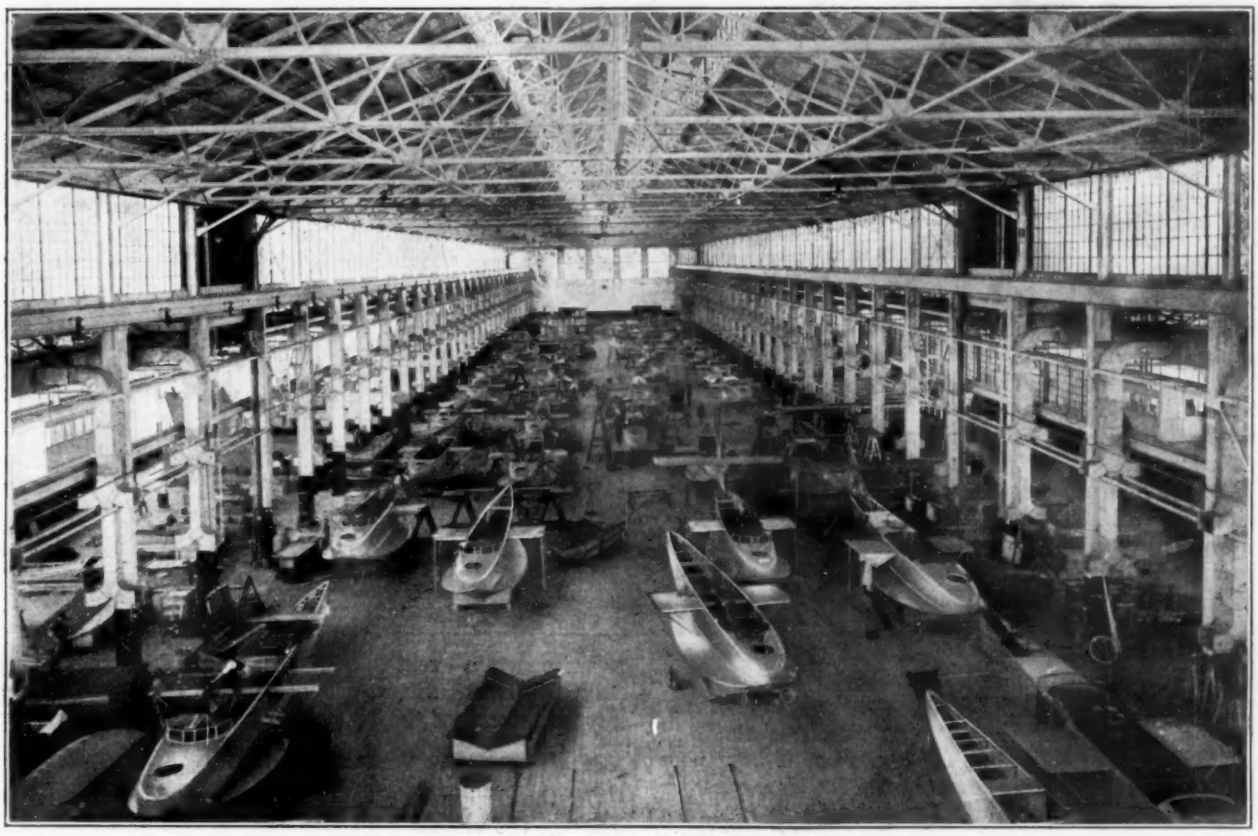


FIG. 4. FINAL ASSEMBLY PLANT

A training school was established and the women were placed in it, and under the close supervision of mechanical instructors they performed the same kind of work that they would later be called on to do in the factory. The work they did was production work, but it was graded so that a beginner had similar work and was more closely supervised. With these exceptions and that of a shorter work day the working conditions of this school are made to resemble as nearly as possible the rest of the factory. A sufficient number of girls passed through the school to increase the number from 218 in June to 895 in November. This was an increase from 9.4 to 24.5 per cent. of the entire force.

Most of the women employed on mechanical work were used in assembling airplane wings, but they were also extensively used in the metal and machine shop, the wing covering department, the sawmill, the hull shop, in painting, subassembling, inspection and in the storeroom.

A similar training course was conducted in the fac-

FIG. 5. GIRL WELDING SMALL PARTS

tory for the enlisted men who were to be sent abroad for assembling and repairing seaplanes.

Utilization of the Plant

At the time the plant was first projected, it was not known definitely what planes would be put into production therein, but it was designed practically with the idea of manufacturing training planes. Early in October the supply of training planes being assured and the supply of service flying boats being in doubt, it was decided to put into production an enlarged order of fifty twin-engined flying boats of the type known in England as F-2-A and in the United States as the Curtiss model H-16, Fig. 2.

The engineering data were obtained from the Curtiss Aëroplane and Motor Corporation and to discuss the engineering problems involved, it is perhaps necessary to show the relation between the Naval Aircraft Factory-the Navy Department and other airplane factories. The Naval Aircraft Factory was designed to supplement, not to compete with, privately owned factories, its after-the-war future being intended for the development of new and experimental models. During the war its function was to be practically one of production. Located as it was in the Navy Yard and in charge of an officer known as the Manager, it was necessary for the Manager to be under the Commandant of the Navy Yard insofar as military matters and matters of general external policy were concerned.

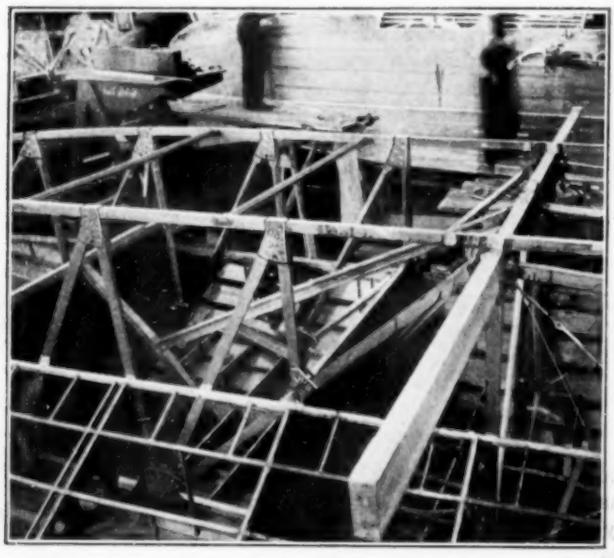


FIG. 6. "AVERAGE FITTINGS" IN HULL ASSEMBLY

The Bureaus of the Navy Department provided an independent inspection service at the Naval Aircraft Factory under the general direction of the Bureaus, just as the same service was furnished to privately owned factories. Communication with other plane factories was direct on matters not involving the inspectors' interests directly and correspondence was through the inspectors and under the same conditions as those imposed upon private manufacturers.

Engineering Problems Involved

One of the principal problems of the engineering department was to apply the practice of part design for matching production to the manufacturing problems of the factory, and in the second model put into production, the F-5-L, Fig. 3, a considerable difference was made to facilitate manufacture in many features. Often the most complicated fittings were so designed that they could be assembled, drilled, brazed, etc., by women, Fig. 5. In the hull of the first model there were about 15 different kinds of strap fittings for securing stanchions to each other and to the longerons. By reducing the number of different kinds of fitting the number of dies, tools and jigs for their production was reduced; it was easier to supply the shop and there was less opportunity for confusion; hence "average fittings" were designed so that some one kind of fitting could be applied to two or more different places. The result of this practice was that no fitting seemed exactly to fit, but outside of the loss in appearance the net result was a gain. Fig. 6 shows some typical average fittings.

In many cases, particularly at first, substitutions were necessary on account of lack of specified materials or parts. The engineering department was called upon to suggest and to pass on substitutes. Many times reference to the stress diagram enabled a simple substitution which saved a great deal of time and aided production. All such substitutions were of course taken up with the proper bureau of the Navy Department and authorized.

Bolt Practice

In the design originally put into production in this factory the variation in diameter of bolt was by $\frac{1}{32}$ in. and in length of bolt by $\frac{1}{16}$ in. As these bolts were all of special dimensions and of special stock heat-treated and electroplated for protection against corrosion, and as the number of sizes was great, production difficulties and complications arose due to long-parts lists, numbers of drawings, specifications, contracts, stock bins, stock cards, etc. Therefore, five diameters were adopted as standards by the department, namely $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$ and $\frac{1}{2}$ in., and the variation in length was made by $\frac{1}{8}$ instead of $\frac{1}{16}$ in. By this means the number of sizes was reduced enormously.

In the early practice castle nuts and cotter pins were used on all bolts. These bolts were, of course, hardened by heat-treatment, and it is exceedingly difficult to drill them on assembly, requiring much time, causing the breaking of many drills and frequently, on wing panels, resulting in damage to the fabric, which required patching. This practice was immensely simplified by the use of washers under all nuts bearing on metal surfaces; and nuts bearing on wood surfaces were headed over unless it was necessary to have them readily removable. This reduced the assembling time of many assemblies and further simplified the production problems.

Many changes in construction were necessary for a

number of reasons. In spite of the utmost effort drawings were frequently incorrect because of insufficient data on the strength or nature of materials, because of hurried preparation to meet requirements of the shop or incomplete checking because of limited time. There were also changes in design to permit substitution for materials not obtainable or eliminate weakness developed by test, or provide improvements found necessary by oversea use, reduction in weight, or to further standardize or reduce the number of parts. All these changes had to be met with the least interruption to the shop schedule which had been prepared for the parts in question.

The variety of materials required was greater than would at first be supposed, many of which were both in character and treatment unfamiliar to the workmen, necessitating experiments that frequently resulted in ruining parts. All materials passed through rigid inspection not only on receipt at the factory but after each stage in manufacture.

Special Tools and Fixtures

Methods, tools and appliances were in many cases new or untried, or adaptations from other trades, as, for example, an emergency blanking die, good for from 100 to 500 pieces, which could be manufactured in our toolroom in from 12 to 24 hours. The die was mounted on a base and separated therefrom by spacing blocks somewhat thicker than the material to be punched. The punch was a loose piece of machine steel guided to the die by the guide block, held in position above the die. This device was used on ordinary stamping presses for material to and including ⅛ in. thick.

Jigs and fixtures for bending, welding, cutting, drilling and testing and frames for setting up an essembly were developed and built up by crews in each shop designated for the purpose, Fig. 7.

A feature new to most of our workmen was the small tolerance permitted in wood, as well as in metal, to obtain minimum weight and avoid hand work in assembly.

The floor space allotted to the various shops was based on the speed requirements indicated by the program chart and so arranged that the flow of material was as much as possible in a forward direction with a minimum of back-tracking; subassembly storerooms were located at convenient points in the line of flow of material between the shop where the part was manufactured and the shop where it was used. In this manner large storage areas were avoided and the subassembly storerooms were continually under the eye of the shop foreman, while records of their contents could be reported daily to the manufacturing office, where the records were kept and orders so issued as to keep the various crews busy to avoid accumulation of parts, thus saving floor space and delivering finished parts and sub and major assemblies when, where and as required.

The first order was for 50 seaplanes to be delivered by July 1, 1918. Early in March a program was mapped out after consultation with the foremen of the shops, showing when we could reasonably expect to complete the first plane, then in process of construction. With that as a beginning date a curve was drawn to July 1, the date of completion, showing the number of planes to be completed week by week, increasing as the men became expert in their work, as more men could be obtained and trained, as more rapid and uniform supply of parts could be acquired and as the organization improved. From this program for finished planes there was prepared a schedule showing the dates on which were to be completed each hull, each set of panels, etc. From this in turn were scheduled the dates on which the necessary number of metal, wood and other parts would be required, then the dates on which materials for such parts should be delivered and tools for their manufacture secured. These fundamental schedules were placed in the hands of the supply department, employment department and foremen, and systematically followed up, the progress made in getting men and materials being followed by progress curves, which were compared daily with the schedules showing like requirements. This method not only gave warning ahead of time of what would be required by each foreman for the accomplishment of his program, but also told him what would be required from his shop on any given date.

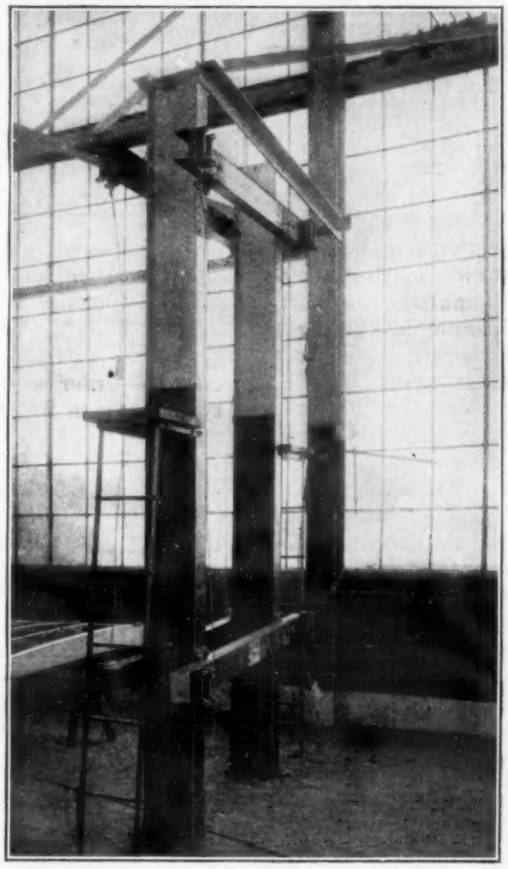


FIG. 7. WING-ASSEMBLY JIG

Drawings and instructions were scheduled in the same manner, which made it possible to concentrate first on drawings for parts which required longest to manufacture or which were needed earliest in the construction of the plane.

In the usual manner the manufacture of wood and metal parts, assembling of panels and hulls, painting and final assembling were assigned to separate shops, the work of each separate shop being further subdivided by crews doing similar work, every effort being made to select for these crews men or women who were by previous experience or shop training familiar with the particular type of work.

As an illustration of the advantage of subdividing the

work so that each man was given a job that he could repeat day in and day out there is cited the method of building hulls. The earlier hulls were built by separate crews, each building an entire hull, and as a natural result each man in the crew performed such a variety of work that no one did enough of any one thing to learn how to do it well and rapidly. The shop was full of hulls in various stages of completion; it was with great difficulty that the materials required by each crew were kept on hand, and more or less confusion was the result. There were nine of these crews, varying in size from 15 to 25 men, and the first step in separating the job into its component parts was to select the operation requiring the greatest number of man-hours. This was found to be the planking of the bottom of the hull. At first this operation required a crew of 20 men working 4½ days, or 900 man-hours. By increasing this crew to 40 men the time was reduced to one day, or 400 man-hours, the men working without interfering with each other or any of the crew, as the hull was theirs for that day.

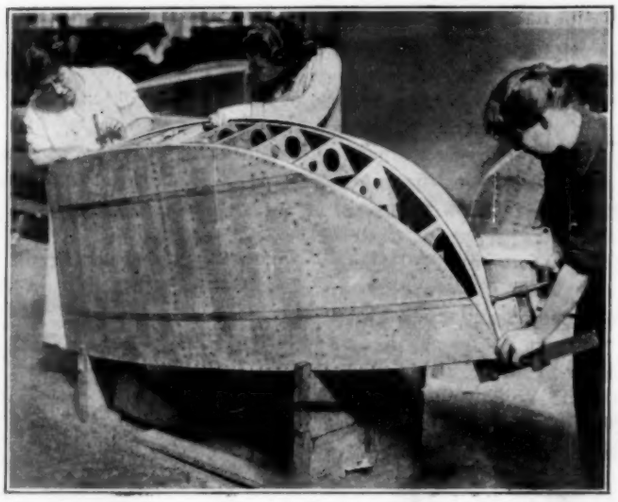


FIG. 8. PLACING PONTOON PLANKING

The construction of the hull was divided into such operations as framing, brace wiring, planking, etc., each of which covered a similar kind of work. These operations were then grouped so that as many crews as possible could work on the hulls at the same time without interfering with each other, after which the various crews were built up so that each group of operations was completed in one day. By this method the time required to complete a hull was reduced from 41 days to 16, which not only saved time and men but floor space, as by providing 16 berths we secured the delivery of one hull a day; by apportioning the construction of the hull to 16 crews, each doing a day's work on each hull, it was practicable by having 16 planes under construction to have all planes simultaneously undergoing separate operations, and have each crew move from one plane to the next at the end of each day, thereby giving place to the crew performing the next operation. The speed of delivery was later raised to more than one plane a day by increasing the number under construction at one time.

The same method was followed out in the final assembly of planes. Whereas the first plane required for its final assembly 50 days with a crew of 35 men, the second 27 days, the third 17 days, this time was finally reduced to 7 days. In the subdivision of work in final assembly every effort was made to remove from the plane such work as could be done elsewhere, as, for example, the wiring of the hull for heat, light and ignition. At first this required 114 man-hours per plane. By assembling parts on benches this was reduced to 73 man-hours per plane. The time on the plane itself was at first 30 hours and was later, by the use of jigs, reduced to 10 hours. The advantage was not only in the reduction of labor cost but also in the completion of the work in a short time. The hull is delivered to the final assembly floor with the wiring board in place. This board is removed, placed on a jig, and in 1½ hours is ready to replace on the plane. In 30 min. after the wiring board is completed on the jig, it is replaced in the plane and all dependent operations may proceed, the wires having been previously cut to gage, terminals fitted and soldered, wires assembled by charts and errors practically eliminated. It may be mentioned that the work on this jig covered three systems of wiring; namely, heat, light and ignition, and that women learn to do this portion of the work in a day.

FIG. 9. AN EXPERIMENTAL STRUT

Another example of the sub-division of labor is in the construction of pontoons, which under the first method of having one crew build the pontoons complete required 279 hours per pontoon. By dividing the construction into various operations, each performed by a separate crew, Fig. 8, the time was finally reduced to 40 hours per pontoon.

As to progress in cost reduction it may be stated that the factory cost, including overhead, of the last 20 boats out of the first order for 50 was less than half that of the first 10 and was considerably less than the price at which the Navy was buying these boats from other plane factories.

The term contract manufacturing is intended to cover the production of hulls, assemblies and parts by private manufacturers for assembling at the Naval Aircraft Factory, as called for by the enlarged program referred to in the foregoing. This required a separate department. It will probably be agreed that it is much more difficult to hire other plants to do one's work than to do all the work oneself, because of the difficulties in placing orders, con-

tractural relations, getting the contractor to manufacture the goods as wanted and deliver them when wanted, the difficulties introduced by transportation, to say nothing of the difficulty of maintaining quality and holding-down prices.

In this particular case the problem was much more difficult because none of the contractors understood the work and they and their workers had to be taught. Although every effort was made to choose sources already completely equipped this was not practicable, and it was necessary to add to the contractors' equipment in many cases and to a considerable extent. War conditions made it hard for private manufacturers to get material and labor and to hold their labor. Transportation problems were difficult beyond all expectation and altogether the manufacture of parts in subcontractors' plants is an undesirable policy. In defense of it there can be said that the Naval Aircraft Factory got its parts almost as fast as they were wanted and that by dint of exceedingly careful and thorough instruction the required standard of quality was maintained. Also the Navy finds itself, now that the war is over, with a much smaller plant expenditure on its books than it would otherwise have had.

The policy in placing contracts was to select plants as nearly as possible properly equipped and of manufacturing experience which made their organization and personnel readily adaptable to the production of aircraft; also to establish for each part or assembly two or more sources in different localities so as to protect the manufacturing program against interruption in supply.

In each plant was established a branch office of the Naval Aircraft Factory in charge of a manager, and with production, inspecting and teaching assistants. Service was extended to the subcontractors in getting material and labor, because the Naval Aircraft Factory organization knew better how to deal with the bureaus of the Navy Department and with the other departments, commissions and boards of the Government.

Most of the contracts were made on a cost-plus profit basis and therefore in each plant the Bureau of Supplies and Accounts established a cost inspector. No extraordinary difficulties were experienced by the Naval Aircraft Factory in the operation of these contracts.

The reason for having a separate organization of the contract manufacturing department was found in the fact that the manufacturing department of the factory proper was struggling with its own program and making good headway and it seemed better to establish a new organization than to interfere with and possibly destroy a satisfactory organization before it had acquired the stability of motion derived from experience and habit.

Later, as the original organization became stabilized, the disintegration of the contract manufacturing department was begun. Inspection was first taken over by the engineering department. Later the material section of the manufacturing office took over general charge of the entire manufacturing program. Again, the largest source of metal parts and assemblies, which had at first been under the cognizance of the contract manufacturing department, was shifted over to the manufacturing department and one of its superintendents placed in charge of the work there. The cessation of hostilities found the contract manufacturing department reduced to about half its original size and scope.

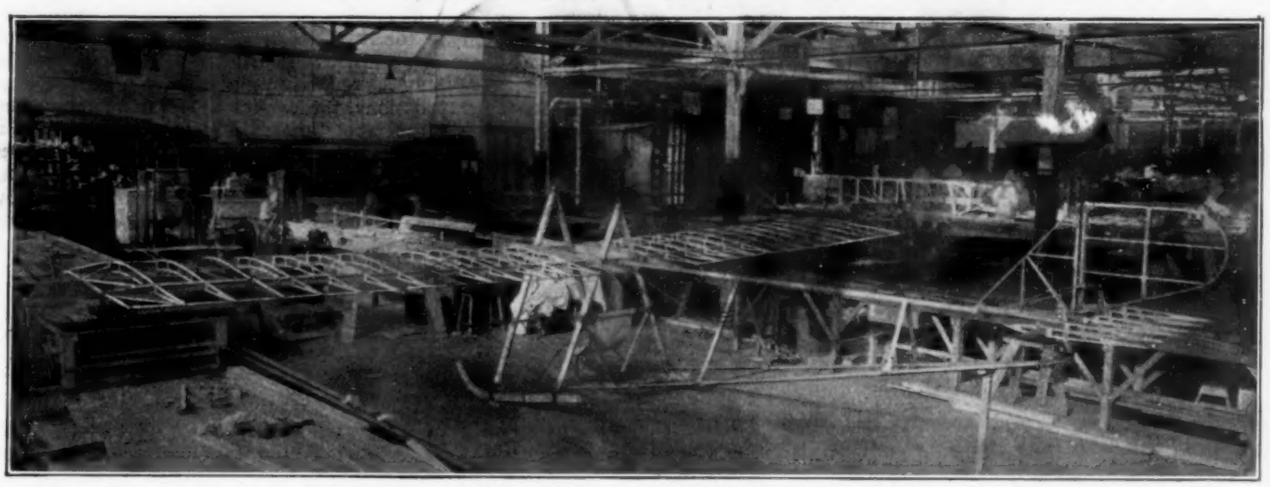


FIG. 10. EXPERIMENTAL MONOPLANE SKELETON

The present date finds the Naval Aircraft Factory reduced in volume of work and changed in its policies and class of work. At the time the armistice was signed there were employed in the Naval Aircraft Factory proper some 3740 persons and in the plants of subcontractors nearly 8000 more. Work has been discontinued in the subcontractors' plants and the force at the factory reduced to 2000. The large new assembly plant has been converted into an aircraft storehouse. The storehouse building is being filled with raw materials and partly or wholly manufactured parts and assemblies. The large-scale production of boats has been stopped. Those boats which were so far along as to make it good business for the Navy to protect its investment by completing them are being finished, and being good standard craft they will be suitable to the peace-time uses. The factory is giving its attention to the manufacture of training planes and to designing and construction of experimental models—developing the art of flying. Figs. 9 and 10 show some of the work that has been and is being done. In stopping of work in the subcontractors' plants the policy was adopted of effecting an adjustment which would be mutually satisfactory. No arbitrary cancellations were issued. So far as possible opportunity was given the contractor to taper off his work and to return to peace-time activities without any greater shock or disturbance to his organization than could be accommodated by its inherent elasticity.

An Efficient Training Department in a Large Plant*

Labor turnover is a much more expensive matter than was realized a few years ago. Ye old-time employer paid but little heed to its cost, nor was it necessary, for his men stayed with him for years. With the waning of the apprentice system came the shortage of all-round men in the machine shop, and after that the advent of the specialist who could only operate one type of machine, and that, as a general rule, inefficiently. Then labor turnover increased until its cost became enormous. This together with the shortage of all kinds of help, due to the war, was the incentive that brought about the training school.

A REMARKABLY successful training department in an Eastern plant, at times employing over 10,000 people, is cited by Charles T. Clayton, director of the United States Training Service, as a most helpful example of effective factory instruction of the type now keenly interesting many American manufacturers.

This training department, like those in some 250 other plants in the United States, makes beginners efficient producers in a brief period, and, what is far more important, makes the poor and mediocre employees already in the force so productive that the whole force is lifted to an average which many experienced factory superintendents recently would have declared to be impossible. To bring this about the concern has chosen qualified operators from its force and trained them to be instructors—an arrangement which, it has been shown repeatedly, is far superior to haphazard instruction by foremen or fellow employees.

The results of such haphazard teaching are far worse than the average manufacturer realizes. Facts gathered by the training service tend to show that three out of every four workers contribute much less than the average production of the four, and that the average of the three frequently falls as low as 35 per cent. of a fair day's output. There are approximately 10,000,000 persons now employed in American factories. If three-fourths of this great multitude is producing at the rate of only about one-third its potential capacity, the extent of loss to our national efficiency is appalling.

The training department is designed as a permanent feature of the plant for upgrading the less efficient workers in the regular force. By upgrading is meant the improving of an employee's output by brief intensive training in the best method of performing a single operation or a series of operations. When a large number of workers are being hired, the efforts of the department are necessarily largely given over to giving instruction suited to newcomers.

Great care was taken by the management in locating the school. The space finally chosen measured 62 by 128 ft. and is on the top (fifth) floor of one of the large buildings, immediately above a restaurant. This location is much quieter than other parts of the plant, so that it was possible to carry on oral instruction in the lecture room without difficulty. The lecture room is in the corner of the training department, and is inclosed in double partitions that quite effectively shut out the sound. Adjoining the lecture room is the workroom, equipped with machines for instruction.

The staff is in charge of a director, who also is head of the concern's four-year apprentice course. Under him is a supervisor, who, in turn, is directly in charge of the instructors. When the school is running at its maximum capacity of 150 students there are 14 instructors, all chosen from the regular working forces on the basis of their skill, general intelligence, and ability to impart information. Each of the 14 is assigned to a certain type of machine but is sufficiently skilled to demonstrate on other machines, when occasion arises. Such of the instructors as are not needed because of reduced enrollment are returned to the producing force with pay at the regular rates. As instructors they are paid a flat rate.

The first step of the course, which is brief, consists of a lecture given by the director or supervisor. The management places much emphasis on the subject matter of this lecture, because it is very essential that the students get the proper impression at the outset. If newcomers, they are forming their first estimates of the plant, and should they be handled unwisely they may acquire prejudices which it will take months to overcome. For those classes of students who have already worked in the plant, this lecture furnishes the first close contact, in a long time, perhaps, with persons who are looked on as directly representing the "main office." Whether the students are beginners or old employees, it must be borne in mind they look on the training department staff as personifying the spirit and purposes of the management.

Strengthening the Morale

The opening lecture effectively emphasizes the necessity of each employee learning his task well; it explains the vital need of observing safety rules; it stresses the importance of using medical aid in case of minor, as well as serious injuries, and it closes with a presentation of the employee's opportunities and responsibilities. Where all of the class are old employees the address may be omitted, but it is pointed out that it is better to utilize this opportunity for personal touch with these workers, because it has been found that a large proportion of them were astonishingly ignorant of many things covered by the regular lecture.

Following the address the employees are assigned in groups of five or six instructors, who take them to the adjoining rooms, which are equipped with approximately 80 machines. These include hand, power, and thread-milling machines, drilling machines, tapping, shaving and riveting machines, foot and power presses, hand screw machines, turret lathes and automatic screw machines. The students of each group, after a demonstration, operate their machines in turn. Each movement is watched closely by the instructor, who realizes that the right or wrong habits of action may be formed at the very outset. If the instructor deals with the situation tactfully he can soon develop a rivalry among his learners, each of whom will try to outdo the other in the speed with which he masters operations. The very presence of associates is an incentive for each one to do his best.

While the instructors do not adhere to a cut-and-dried method of teaching, the subject matter which they are required by the director to cover is included in about 30 mimeographed sheets of directions which are supplied to them. The matter in these is prepared with much care. It tells the teachers how to describe the machine under consideration and what its uses are. It is important that the instructor make this part of his work very simple and clear, as it is more difficult than many realize for a person intimately acquainted with the operation of a machine to clearly describe that machine to a novice. The instructors are taught to make sure that each term used is understood as they go along. The preliminary explanation is followed by a careful description of the raw materials, lubricant, cutters, jigs, fixtures, gages and other equipment.

Another phase of the instruction which the planners of this course have not neglected is the fact that each employee must be regarded as a human being and not as an impersonal unit in a vast organization.

*From a bulletin issued by the United States Training Service, Washington, D. C.

Each instructor is supplied with cards, one for each student, which are filled in daily, presenting ratings as to adaptability, speed, quality of work, conduct, and attendance. These records are carefully kept, no instructor being allowed to put down "90 per cent." or "100 per cent." as a mere matter of form. When the student is released from the training department the averages are recorded on a permanent record sheet.

With the transfer of the student to the shop at the end of the brief course of training, the management's interest in his progress by no means ceases. A card with his name is placed in a "tickler" file, so that it will automatically come up for consideration in three months, at which time another report on the person's adaptability, speed, quality of work, etc., is secured from the shop foreman. In case the foreman carelessly rates the worker at "100 per cent." simply because he is not grossly inefficient, the card so marked is promptly returned for a more careful rating. One or two experiences of this sort teach those in charge of the workers that the management wants a careful report of each employee's performance.

This method of keeping records helps the office to make sure that the operating department is actually getting the benefits of the training and also serves as a valuable check on general conditions in the plant. If, for example, the foreman reports unfavorably on several employees who made good records in the training department, it is very probably an indication that something is wrong in the section where the trained employees are working. It may be that there is unnecessary delay in supplying the workers with material, or that they are being discriminated against. In any event there is good grounds for investigating the causes of the discrepancy between the two sets of reports.

Advancing the Workers

There is still another way in which the benefits of the training department are conserved for the benefit of the concern. It consists in preparing a list of employees who have high training records and whose production during the first three months in shops is the best. When it is necessary for the employment department or others to procure the services of an especially skilled worker—often on a job paying higher wages—the selection is made from this list. Employees, knowing at the outset that such a list will be made, have an additional incentive for doing the best work.

The work done in training operators to be adjusters is illustrative of the instruction which is strictly upgrading. As the need arises, the more skilled and promising operators in the plant are chosen for this course. These students are taught to take a machine apart and to assemble it, after which they are taught just how to make the various adjustments quickly and intelligently. If they have been alert as operators they will have acquired much information which will make the instructor's work easy. This particular form of upgrading requires two or three weeks.

In the course of six months 2500 employees have received instruction in the training department of this plant, and the results obtained more than justify the expense.

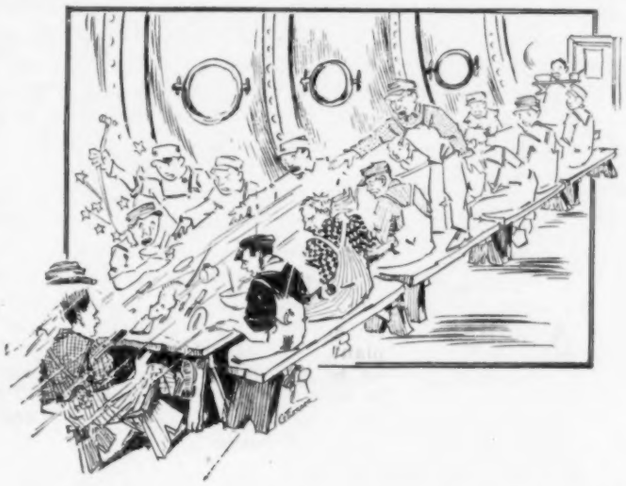
The United States Training Service stands ready to furnish expert advice and assistance in establishing just such training departments in other large plants, without cost. It is prepared to assist the factories of a few score or a few hundred employees equally well and show them how they can upgrade the majority of their force to the mutual benefit of the managenment and the worker. Training such as this branch of the Government is promoting is already a permanent thing in many plants. No progressive manufacturer can afford to neglect investigating training-department methods. Full information can be obtained by addressing the United States Training Service, United States Department of Labor, C. T. Clayton, Director, 618 Seventeenth St., N.W., Washington, D. C.

The following bulletins have been issued by the United States Training Service: "How to Start a Training Department in a Factory," "A Successful Apprentice Toolmakers' School," "Training Employees for Better Production," "Training Labor for Peace Time," "Labor Turnover and Industrial Training," "Industrial Training and Foreign Trade," and others.

Night Life in a Shipyard During the War

By Clarence F. Getzlaff

In an article on page 828, Vol. 50, I related the experiences of some of the men who took advantage of the shortage of labor and tried to bluff their way into the machine game for the sake of the high wages prevailing in the shipyards at the time of the great rush. In this article I will portray a few of the things



that happened to some of us who were fortunate enough to possess sufficient knowledge to get by.

I shall not soon forget my own advent to the maelstrom of activity that set apart from its surroundings the particular yard wherein fate had decreed that I should do my little "bit" toward making the world safe for whatever it has been made safe for. I arrived late at night in a cold wet drizzle of rain, and proceeded to the "barracks," being buffeted about by cold and particularly wet blobs of wind that seemed to be anxiously waiting around corners to meet me and get into my eyes or down my neck.

Reaching the "office" somewhat wet, weary and disgusted, I was taken in hand by a heartless clerk who proceeded to put me through a "third degree," requiring that I lay bare my personal history in the matter of name, age, nationality, color of my eyes, previous condition of servitude and a number of other details that need not have concerned him; after which, to test my generosity or credulity, he touched me for the small sum of 25 cents in return for a key that was supposed to fit a locker, and the information that my room number was 54.

I hunted up room No. 54 which I invaded, finding therein three bunk partners, one of whom was from my own home town. "Gee! but it's great," etc.

When I had finished unpacking my tooth-brush and safety razor and stowed them safely away, it was time for dinner or lunch or whatever it was—the other fellows called it "eats"—which was served aboard the old side-wheeled steamboat "Chicago," affectionately dubbed by the boys, the "hash foundry."

The memory of those long tables set forth for the night gang will linger with me for many years. I am not sure that the tables "groaned with the weight of goodies" as they do in story books, but I certainly heard groans from *some* source when the soup was brought on. However, this difficulty was soon disposed

of and the cheerful rattle of table cutlery and "china" that followed was almost drowned in the hum of conversation from which stood forth such terse and illuminating phrases as "chuck over the sugar bowl," "drive the cow this way," "a little mo' 'lasses, please," and "pass up them spuds! thank you." "Well," thought I to myself, "these fellows are regular guys; it ain't going to be so bad."

And this indeed proved to be the case. There were many minor discomforts, but on the whole we fared as well as could be expected under the circumstances. While there were outspoken as well as heartfelt remembrances of the kind of cooking that "mother used to make," there were no real hardships. Our boys were for the most part a jolly, happy-go-lucky bunch, bound to make the best of an uncomfortable situation and get all the fun out of it that was coming to them.

Soon after getting down to the business of supper, there was a crash and a scurry among the dishes as a large-sized rat, something less than a foot long, jumped onto the table and tried to make a get-away with about a pound of cheese. He didn't make it, so far as the cheese was concerned, but in leaving he took with him several basketfuls of knives, forks, spoons, etc., as well as a few plates and coffee mugs. The stewards, however, being members of the S. P. C. A., as well as being responsible for breakage, sternly discountenanced this form of cruelty to animals, and soon silenced the barrage, allowing the rat to reach the cover of his first-line trench undamaged.

The episode of the rat was a severe strain on my poor little "tummy," but as the other fellows did not appear to mind it I took a brace and whispered to myself, "Cheer up, old top, the worst is yet to come." I later became quite accustomed to dining surrounded by the family pets.

Pleasures cannot last forever. The "eats" were soon disposed of and I went with the gang to the shop where I was introduced to the night boss. This individual, rendered somewhat skeptical no doubt by the frequent endeavors of would-be mechanics to "put one over" on him, questioned me sharply as to my previous experience, especially with reference to the class of work I was accustomed to, and when I had convinced him that I knew which side of a lathe to stand on he piloted me out into the shop and left me in charge of a 36-in. Lodge & Shipley lathe.

The first sight of this machine was not exactly reassuring, but before many nights passed I had discovered that running this lathe was considered one of the best jobs in the shop, as to this machine came tail shafts, intermediate shafts, thrust bearings, and kindred pieces, some of them requiring a considerable degree of skill.

Now I am not exactly a natural grouch, and perhaps my "personal magnetism" was what attracted odd and sundry helpers to the shadow of the headstock of my lathe, or maybe the fact that from that point of vantage they could see the boss on his rounds without being observed themselves, had something to do with it. Then, too, those same helpers could always be furiously making ready to get the next big job in the lathe for me if the foreman came unduly close. However, it transpired there were usually three or four of them there and many a surreptitious song and story was drowned by the growling of gears and hidden by the shadows of flapping belts and moving machinery.

Many and fruitless were the errands upon which helpers and apprentices were sent, and no matter how ridiculous the outcome, nobody ever was "sore" for more than a few minutes. Left-handed monkey wrenches and strap oil became too common to notice, the former being instantly produced from anywhere, while if anybody had the temerity to ask for strap-oil he was likely to get it, promptly and vigorously, from a 3-ft. piece of belting of handy width, leaving him in some doubt as to its desirability.

"Go over to Hawley and get me the brass tester," I said one night to one of the boys, as I indicated to him a chum working on the other side of the shop. He went over unsuspectingly enough and I could see across the maze of machinery the earnest conversation, the mystified gestures and pointings with which my message was delivered and received.

Somewhat to my surprise the boy on leaving Hawley headed for the shop office where he had a talk with the boss, and it was with a peculiar crawly sensation in my boots that I beheld him threading his way back to me. "The boss says for you to go to 'ell," said the boy, and I soon found that Hawley had scored off me by sending the boy to the boss for the "brass tester."

What a "Drill Stretcher" Looked Like

The foreman himself was not above playing a joke or two at someone else's expense, and one night spying an idle helper he sent him in search of the "drill stretcher." The helper went from one workman to another; many in their ignorance denying in good faith any knowledge of such a tool; others, better posted, sending him onward to search in another place until at the far end of the shop, a screw-machine hand indicated a 6-ft. bar of 3-in. cold-rolled steel leaning against the wall, telling him it was the long-sought tool.

Shouldering the 150-lb. burden the luckless helper staggered back to the foreman and deposited the husky "drill stretcher" at his feet. "Now do you know what it looks like," demanded the foreman.

"Sure! sorr," said the helper.

"Then take it back where you got it, and see that you remember it."

Notwithstanding the tricks that were played, the stories that were told, and the songs that were sung, the night gang, man for man, turned out more and better work than the day gang, and I remember hearing a public speaker say at our yard that if the yards of the Great Lakes had the facilities that were at the disposal of the Atlantic Coast yards, Uncle Sam would be getting ships faster than he ever dared hope for them.

Oh hum! It's all over now. Perhaps the songs and the jokes helped, along with the numerous other things mentioned as winners of the war. One lesson is learned; the way to get production is to weed out the undesirables, give the rest an incentive, and trust to their sense of honor and fair play to "deliver the goods." Good men don't need to be driven.

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Operations on the British 9.2-In. Gun—III

HAVING finish-turned and bored the body of the gun, there are still some operations to be performed that call for the greatest care on the part of the workmen. The next step is one that is most vital to the accuracy of the gun.

Operation 20.—Rifle—In the rifling machine the gun is secured in a chuck furnished with a dividing worm-

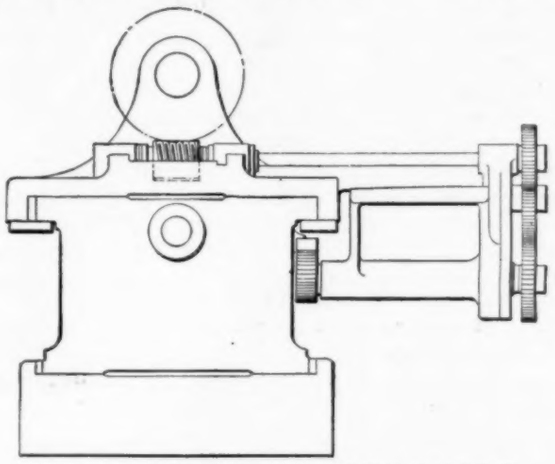

FIG. 17. END VIEW OF RIFLING MACHINE

wheel and carried in supports, a special plate being marked off to suit the rifling on the various guns for which the machine is used. A separate motor is employed for rotating for dividing purposes. On the 9.2-in. gun the rifling is of uniform twist and the gearing shown in Fig. 17 is employed. A steel rack at the back of the bed gears into a pinion and shaft on the saddle. Change wheels lead to a wormshaft, the worm on this gearing into a wheel on the end of the spindle in the head of the bracket on the saddle. The rifling bar is connected to a collar on the front end of this spindle.

The means by which the gun is supported are illustrated in Fig. 18. The dividing support, or chuck, near the center does not really take the weight of the gun. At the left-hand will be seen a roller support which takes the main weight, a detail of the support being given in the end view. To the right of it is a half-center support placed approximately at the position of the center of gravity of the gun body, an end view being given above it. The muzzle end has a combined roller and half-center support, an end view of which is also given.

The rifling head is shown in section in Fig. 19. Inside the head is a sliding rod having a taper portion, which determines the radial position of the two tool-boxes. The position of the sliding bar is determined by a lever system and inclines on the bed of the machine. The steel cap at the end of the bar carries a dirt-clearing brush. The bearing strips in the head are of cast iron 1¾ in. by 1 in., four 38 in. long and two 22 in. long. The guide is supported in bushings in the head as close as possible to the tool, which acts on the draw stroke, and the usual feed per cut is 0.003 in.

Operation 21.—Scrub-out rifling—This is a hand operation. Hardwood blocks are fastened on the end of suitable wooden bars, the blocks being covered with emery cloth nailed on, and the purpose of the operation is to remove burs.

Operation 22.—Cut key clearances—Clearances for the next operation but one are cut on each side of the

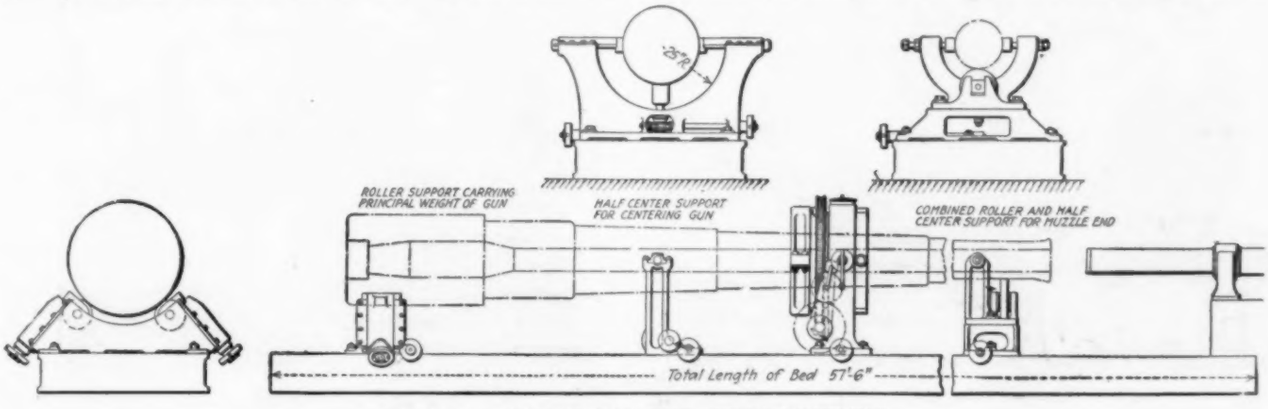
ROLLER SUPPORT CARRYING PRINCIPAL WEIGHT OF GUN
HALF CENTER SUPPORT FOR CENTERING GUN
COMBINED ROLLER AND HALF CENTER SUPPORT FOR MUZZLE END
Total Length of Bed 57'-6"

FIG. 18. SUPPORTS FOR THE GUN IN RIFLING

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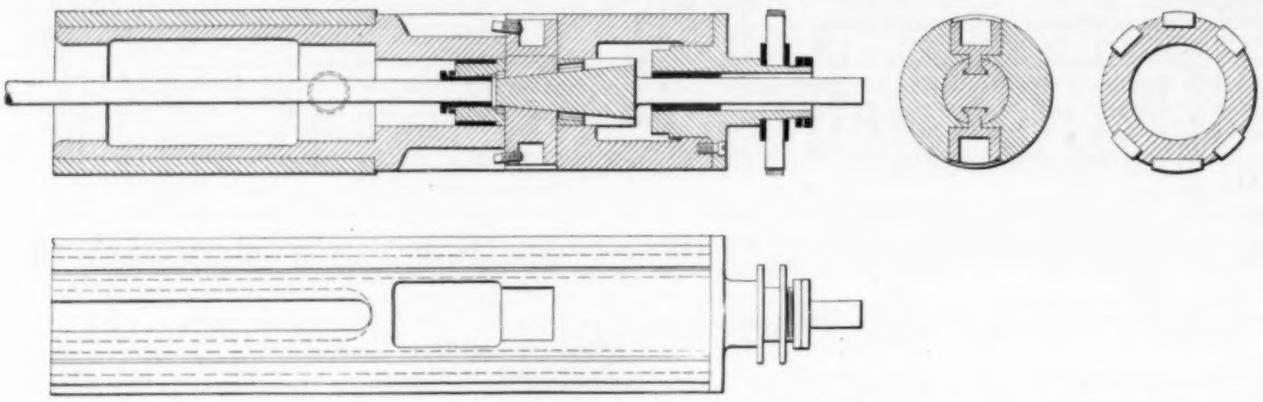

FIG. 19. SECTION OF THE RIFLING HEAD

key, the work being done with an end mill in a horizontal machine.

Operation 23.—Jig breech end of gun and cut hinge clearances—This is a face-milling operation done in the same machine.

Operation 24.—Jump key—The gun is placed in the lathe and held by a chuck at the breech end and supported in a three-point steadyrest at the muzzle end. When the gun is in position the key is on the under surface of the jacket. A stout plate is fixed by a screw on the front of the cross-slide and provided with an adjustable threaded stop pin to regulate the depth of cut. The clearances produced by operation 22 enables a lathe tool to turn the periphery from which the key projects. As the job revolves the tool is drawn out quickly by hand (the crossfeed screw being of ¾-in. pitch), and when the key has passed the tool the latter is placed quickly back against the stop by the same means. The collar shoulder is faced to length at the same operation. This method applies to cases where only a small number of guns are required.

Operation 25.—Fit key to width, etc.—The work in this hand operation consists in radiusing the end of the rifling, stamping the necessary letters of figures on the ends, cutting the axis lines and fitting the key.

Operation 26.—Inspection.

No details of the breech mechanism are available, but reference may perhaps be made to one or two appliances used in the production of this part of the gun. The breech block is swung into position in the bushing before receiving the part turn by which it is locked, and in order that the screw may enter correctly, part of it and a corresponding portion of the bushing are machined to permit the swinging motion. Fig. 20 shows the fixture used for shaping the clearance on the screw. The breech block is fixed on the mandrel *A*, and the toolbox, which can be moved through a circle by means of the worm gear at the back of the supporting frame, is controlled for position by handwheel *B*. The mandrel is on a swinging arm, motion for which is obtained from the ram of a shaping machine, the two being connected by link. The breech block is given the same swing as it has when in position on the gun, the centers being the same.

The device for dealing with the breech bushing, Fig. 21, is of a similar character. The bushing is fixed in the opening *A* of the frame of the fixture, and the swinging arm *B* is operated by means of a rod connected to the end of the shaping-machine ram and to pin *C*. The tool is held in the clapper box *E* and can be revolved by the handle *D* operating a worm and worm-wheel.

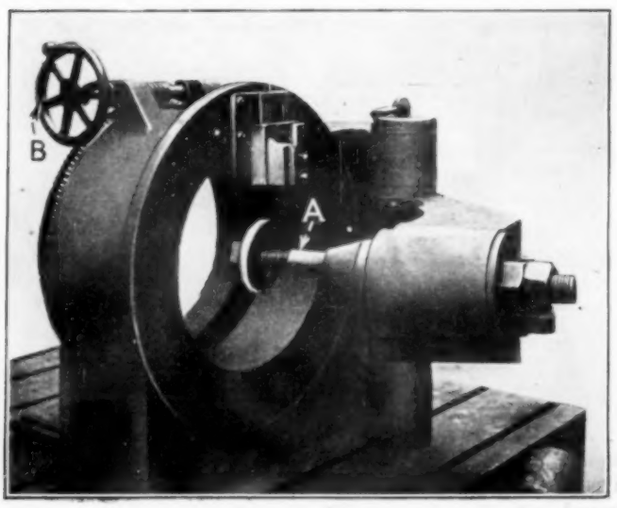

FIG. 20. FIXTURE FOR SHAPING RADIAL CLEARANCE IN BREECH BLOCK

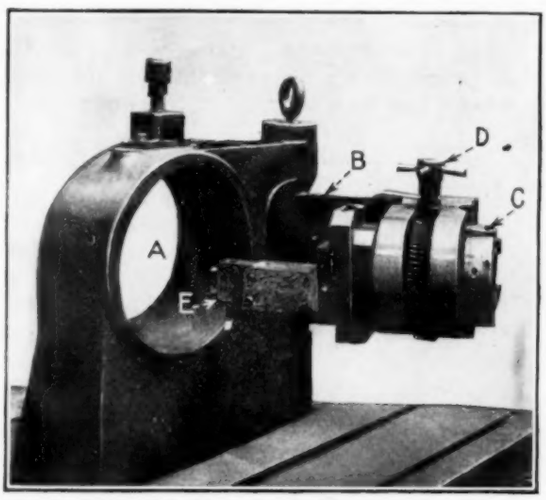

FIG. 21. FIXTURE FOR SHAPING RADIAL CLEARANCE IN BREECH BUSHING

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Reference may also be made to an appliance used for milling a pocket inside the breech-mechanism frame, the latter being essentially a large ring of metal on which are lugs to carry the breech mechanism. Inside each lug a pocket is milled and the device shown in Fig. 22 is employed. The frame is placed on the table of a radial drilling machine on the spindle of which is secured a pulley to drive the appliance shown. At the other end the spindle bears a pair of bevel gears, one of which is tapped, and to this the end mill employed is secured by its threaded end. Without further description it will be seen that the position of the arm can

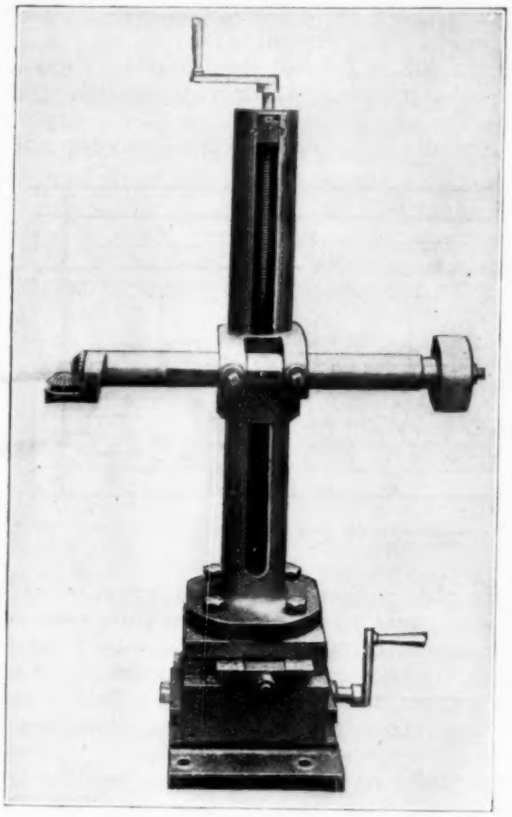

FIG. 22. DEVICE FOR MILLING SEAT IN BREECH FRAME

be adjusted vertically and in horizontal planes at right angles.

In the foregoing the chief machining operations have been specified, and to connect them up a résumé may be given, with a few notes on the building of the gun itself.

The gun being completely machined, the bore is tested by government inspectors, the gun lying blocked up at the breech, but with the muzzle end hanging so that the only drop is due to the unbalanced weight at that end. Starting about 1 in. from the breech end of the rifling, the bore is sighted to the end by means of an alignment instrument extending over a length of 3 ft. The instrument is moved by steps each equal to its own length and the sighting is continued till the muzzle end is reached. The gun is then turned axially through 90 deg. and the process is repeated.

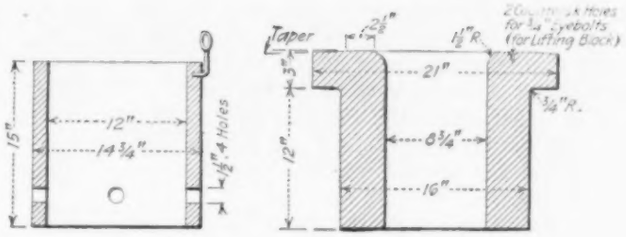

FIG. 23 FIG. 24

FIGS. 23 AND 24. DRIVING FERRULE AND PAD

For determining the clinometer plane the gun is balanced on its center of gravity and a small weight is added at the breech end in order to keep this end down. Inside the gun is placed a straight-edge which rests on circular feet shaped to suit the bore and spaced about 5 ft. apart. The clinometer is placed on this straight-edge, a reading taken and then transferred to the clinometer plane, which is adjusted by the fitter until correct.

Building Operations

The first building operation is to drive the internal A-tube home. The B-tube is then shrunk on, and afterward the jacket. The driving allowance of the tubes is about 0.007 in. and the taper of the surfaces of the two A-tubes is 0.004 in. to the inch, so that when the two tubes are in contact a length of about 1¾ in. remains to be driven. For this operation the muzzle end of the A-tube is placed on a steel ferrule, Fig. 23. The ferrule has a ¾-in. eyebolt on each side for lifting purposes. The four holes at the bottom allow water to run off. The water is required if the gun should have to be heated in case of the inner A-tube becoming fast before it is home. The A-tube is heated slightly at shoulders and muzzle end with gas rings, and the bore of the inner tube is kept cool with a water spray.

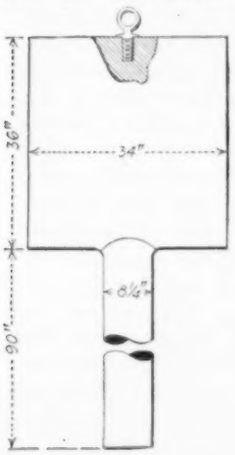

FIG. 25. THE DROP

A plug is placed in the muzzle end of the inner A-tube, and at the breech end a steel pad, Fig. 24, is placed on top of the inner tube to take the blow of the drop, the weight of the latter being about 4½ tons and the fall about 4 ft. The steel drop, Fig. 25, is made with a shank which enters the inner tube through the hole in the pad and is thus kept central. The drop has a 2-in. eyeblot for lifting, and its fall is controlled by means of a drop catch. Generally, between 20 and 30 blows are necessary.

As to the B-tube, for shrinking this is heated from 300 to 400 deg. C., the process taking six hours, as it must be heated both slowly and uniformly. All the temperatures are controlled by pyrometers. At the required heat the B-tube is lifted out of the furnace and lowered onto the two A-tubes, these standing on a stool with the muzzle end up. When lowered on to the partly

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built gun the B-tube breech end rests on the wire-fastening ring. A water ring placed round the lower end is set into operation, and at the same time the muzzle end is kept warm by means of gas rings. The water ring is lifted gradually, the longitudinal expansion being removed by thus cooling and contracting from the breech end and keeping the muzzle end open. The operation takes about half an hour.

The shrinking-on of the jacket is a similar operation, the temperatures being the same, the breech end being cooled while the muzzle end is kept warm. The time of cooling is about three-quarters of an hour. A line turned or scribed about 2 in. from the muzzle end of the jacket when in position on the gun permits measurement of the expansion and also is a check on the stretch in the jacket when it has finished cooling off.

A plan of one of the shops used for shrinking and similar purposes is given in Fig. 26, this shop being

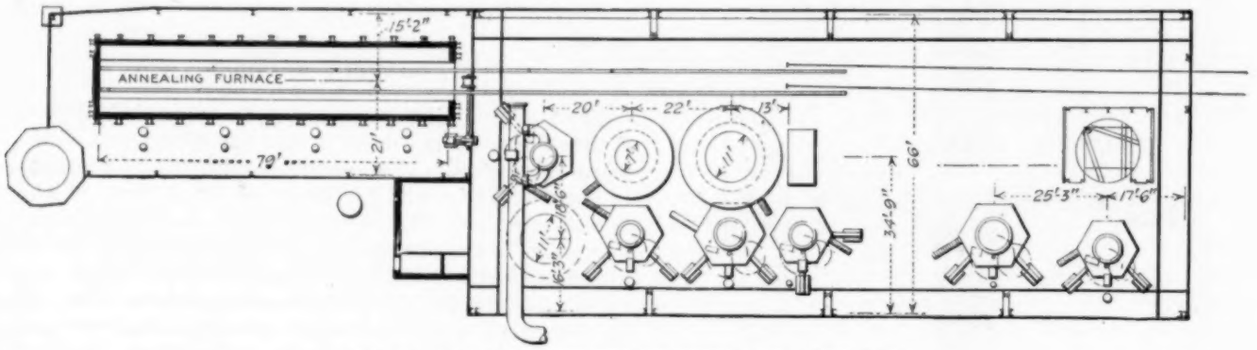

FIG. 26. PLAN OF SHRINKING FURNACES AND PITS

160 ft. long by 60 ft. wide and 90 ft. 6 in. to the highest lift of the crane. There are in fact two cranes at different levels, the bottom one of 30-ton capacity and the top one 120 tons. The vertical furnaces are of the dimensions shown, and the building pit will be seen at the right.

Oil tanks, shown by circles, are up to 70 ft. deep and the shrinking pit is 30 ft. 6 in. deep below ground level. Usually cotton-seed oil is employed, but at present a high-grade mineral oil is in use.

Inspection

Notes on inspection having been given incidentally when dealing with operations on the various components of the gun, some statements may be made as to procedure and allowances regarding details.

The inner A-tube, both before and after driving, is gaged throughout for internal diameters every 10 in. in length from breech to muzzle; comparison indicates how much it has been closed in. It is also similarly gaged after wiring in order to show the collapse due to this. As a result of wiring also the tube lengthens, perhaps by as much as 0.10 in. It is necessary to gage over the top of the wire for the B-tube and for the jacket at 8-in. intervals. In each of the latter instances diameters are measured. From them a card is prepared for finish-boring the jacket and B-tube to suit wiring. The allowance is about 0.005 in.; that is, the B-tube and jacket are smaller than the wire diameter by that amount. After finish-boring the B-tube internal diameters are taken and a card is provided by which the wiring is turned. The same applies to the jacket.

When the B-tube and jacket have been built the bore is gaged and the gun goes to the machine for the finish-boring, the gaging being at say 2-ft. intervals. After the other machining operations, inspectors take gutta-percha impressions of the rifling and also of the chamber, testing the latter against a profile gage. The impressions are of full length in chamber and the rifling is divided into four lengths and in four widths to cover the full periphery. Impressions are taken both before and after proof, and in the former case check the depth of rifling, etc.; the gutta-percha does not change perceptibly in size when hardening.

When the gun is finished the inspectors check over the external diameters and lengths to see that they accord with the plan before proof.

Measurements are made by internal and external micrometers, plate rock-over gages and length rods. Special internal gages are used for taper parts such as the chamber, a stop being placed on the rod of the rock-over gage in order to insure the diameter being measured at a given position on the cone. This is important, as it is necessary to gage at the same place both before and after proof.

On the A-tube all lengths are taken from the breech face of the gun plus the 0.50 in. left on its face until fully built up, and as regards the B-tube it is usual to work off the finished face of No. 3 wire ring from the gun face. For the jacket, work from the finished face of the gun for lengths.

In the chamber, lengths are taken from the finished breech face of the gun and the chamber is gaged for diameter at every 6 in. in straight parts and at four definite points on the cones.

In the A-tube, length rods are made from each shoulder to the breech face of tube. Rods are given out for the inner A-tube to be made to suit as regards lengths. The inner tube is left temporarily long at the breech end to correspond with the face of the A-tube; thus it is possible to carry back the taper in case of mistake by the turner and the gage is then made to compensate for this. When the inner A-tube is turned it is usual to work to the length rods mentioned above. The surplus metal is cut off the inner tube, leaving it 1 in. too long with a good end face. Generally, a length is made from the first shoulder of the inner tube to its face

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placed on the shoulder of the A-tube and a filling-up piece prepared to the end of the A-tube which indicates when the tube is driven home. The same process is followed at the muzzle end except that the gage is made initially from the A-tube.

For the breech bushing it is usual to allow about 0.01 in. on the external diameter; that is, the opening is bored 0.01 in. large. On the collars of the outer A-tube the first step should be correct to length and the second about 0.005 in. longer to insure a bearing on the shoulder at the breech end. The B-tube when in position butts against the No. 3 ring at the breech end and the muzzle ring shoulder at muzzle. A length rod is made measuring from the face of the B-tube to the shoulder, and in finishing the gun the rod is applied from the face of the No. 3 ring to the muzzle end shoulder, leaving the latter about 0.01 in. to 0.015 in. long. The same applies to the shoulders of the jacket, which is built on top of the B-tube, leaving the muzzle of the gun about 0.01 in. or so long.

Screwed collars are bored about 0.03 in. larger than plan size to allow the shrunk collar diameter to be turned to the end frame bore, which is standard. The muzzle ring must be dead on the shoulder of the A-tube at the muzzle end. At the breech end the theaded collar should be well home on the shoulder of the shrunk collar, as otherwise on the firing proof of the gun the theaded ring, which is held on the jacket, will be pushed longitudinally. It is important to have the breech screw and the corresponding threads of the breech bushing and the A-tube exact as to pitch, as otherwise seizing occurs. Slight pitch differences are often due to cutting the threads in different machines.

On the outer A-tube exterior, after the tube has been driven in, the inspector makes a wire-seating size from wiring, not from drawing, as otherwise the gun would be something like 0.1 in. smaller than the plan size when wired. The collapse in diameter is about 0.001 in. a layer of wiring on the outer diameter, and for the full number of wires on the gun the bore of the inner tube will collapse by about 0.015 in. to 0.02 in.

The obturator seat is left 0.01 in. small on diameter before proof to allow for expansion at proof, and is scraped out to plan after proof. A thin disk, say 0.01 in. thick, is allowed between the breech screw and obturator pad before rejection. It may be worth noting that on proof the breech bushing goes back and the inner A-tube will generally go forward.

The Growing Market for Machine Tools in the Dutch East Indies

By J. W. EVANS

There is a demand for machine tools in the Dutch East Indies. It is a growing demand, and it bids fair to reach such proportions that no maker of machine tools can afford to disregard it now at the start. And yet few American makers of machine tools are as yet aware that such a market for their products exists in that part of the world.

IN AN agricultural country like the Dutch East Indies, the use of machine tools depends directly on the extensive use of all kinds of machinery, with the consequent call for repairs and for new parts.

The tremendous growth of big-scale agriculture in these immense islands, particularly Java, has produced that very condition.

Before the war European manufacturers of machinery, having the field to themselves, kept special representatives there to promote their sales. Efforts were frequently made by repair men in Java to get orders for repairing and for the making of renewal machine parts; but they could not compete with the manufacturer of the original plant, for the consumer generally figured that he was more likely to get the right dimensions, etc., from the maker.

An immense amount of the machinery used was of German make. The war, therefore, forced technical traders in that region to turn to England for new parts. But British makers refused to make spare parts for German-built machines, nor would American makers be bothered with such orders because they involved new specifications.

The inevitable result, therefore, was the growth of plants in the Dutch East Indies to fill the demand for such parts, *and the importation of machine tools for the purpose.*

Now that the new idea of homemade parts has got a start, and now that buyers have learned to go to the home market for such things, it is hard to say where the growth of the new industry is going to end.

As far back as 1916 there were 4000 hands working in the iron foundries of Java, and using American-made machine tools. They had a screw and nut factory; 46 automobile repair shops employing 1114 hands, and not only repairing cars but making new parts; 13 railway and tramway material shops employing 3025 hands; 150 miscellaneous shops employing 7220 hands and consisting of constructional workshops, electric factories, machine works, metal work shops, forges, etc.

All these shops and factories have grown enormously in numbers and importance since then. In 1917 they got their biggest impetus through our inability to send them all the machinery and machine parts the Dutch East Indies needed. Today the government station railways are increasing the equipment of their repair shops. The Interinsular (packet) company has local repair shops and makes its machine parts on the spot.

Altogether, the growth of such industry bids fair to make the archipelago independent of outsiders so far as small machine articles and parts are concerned.

A current issue of the *Dutch East Indian Archipelago*, a fortnightly publication in English to be commended to all who want to keep in touch with trade conditions in the Dutch East Indies, contains an item about the establishment in Bandoeng, Java, of an "Ironmongery factory," capitalized at 500,000 guilders, to manufacture "those articles which are principally used in Dutch East Indian agriculture, such as hoes, tapping knives, and other implements." From our point of view this factory is not very big, but it is one of many items which collectively become very significant.

It must be remembered that the Dutch East Indies have a population of 50,000,000, and an area equal to nearly half of continental United States; and that the length of the archipelago is 3000 miles. Development there is just beginning. Anyone who gets in now has a long start on the man who waits till later.

In addition, the future holds at least one possibility which may have very great meaning for the maker of machine tools in this country. An enormous deposit of iron ore, manganese and nickel, reckoned at about a billion tons, has been found in Celebes. The deposit comes close to the surface, and can be worked by developing the water power of three lakes in that region.

The Dutch are planning to develop those mines, and to encourage capital—American capital if possible—to come in there and use that metal.

The Dutch East Indies, therefore, are not only fast developing a substantial demand for machine tools now, but promises greater things in the near future. It is an extraordinary opportunity for men who want to send in representatives to push this growing market to their advantage.

Rehabilitation of the Ex-Soldier

By Maj. Warren Bigelow, U. S. A.
Director, Re-employment Bureau of New York City for Soldiers, Sailors and Marines

A great many young men who were drawn into the Army and Navy had graduated from public school or high school just a few years ago, and like millions of others, drifted into some blind alley where they never could advance and where they simply ground away the hours from Monday to Saturday, week in and week out. The Army took them; they got abroad; they saw the trenches; they even saw Paris; and they worked and they suffered. They have come back with more vision and a bigger outlook than they ever had before. They are not satisfied now to go back into the old blind alley that leads nowhere and pays the same price year after year.

But they don't know what to do. They don't know what they are fitted for besides the thing they have always done. As one man said to me, "When I kept the books all day they were straight at night, but that is as far as I ever got." And there is the stockroom clerk, the helper, the porter, the shipping clerk who makes out bills and tags. Even if they wanted the same old job we can't find enough jobs for them in New York to go around.

New Jobs for Able-Bodied Ex-Soldiers

We have got to rehabilitate these men. I don't mean the wounded men; I mean the men who come back with more vision and desire to do better things than they did before. To that end we have established at this bureau a vocational department, where men who understand a bit of psychology and are skilled in the knowledge of trades, talk with a man and advise him what he can take up, what he is fitted for, and what is open to him. These men are trying to help the ex-service man realize his larger vision, the increased sense of individual power, and the better sense of proportion that he has brought back with him after facing the elemental facts of life. The employer can help us, and in doing so will in a measure repay the dept he owes to those who fought for him; he can make room for these men and can give them a fighting chance to make good and to learn a trade and to earn a decent living wage while they learn it.

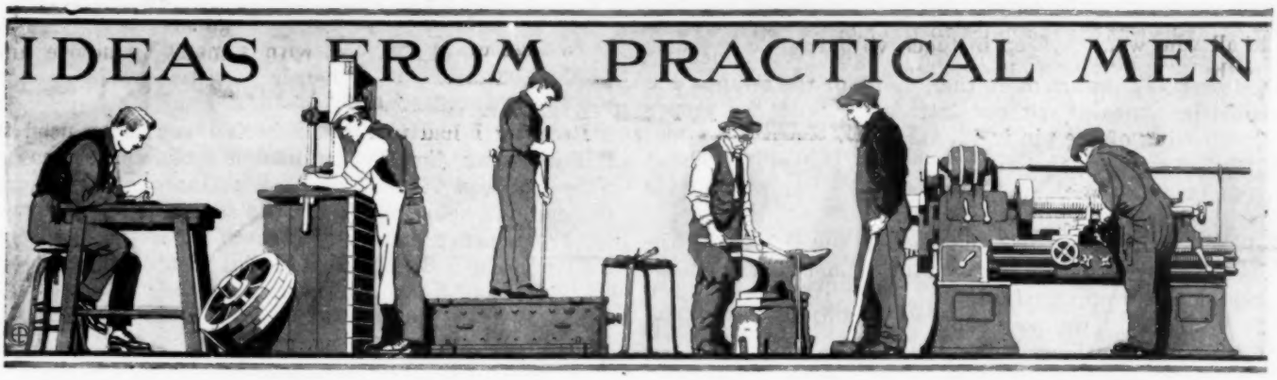
It is true I have heard a good many complaints about service men. Some say they don't want to work. Some say they want too much money. Some say this and some say that, but you'll find a reason for it always. Take this example: We sent a number of boys from this bureau as apprentices to a well-known manufacturer. They were to work at $15 a week while they learned, with high hopes to become manufacturers themselves after they have learned the game. They were put to work moving cases around the storeroom and as the days passed into weeks and they asked the foreman what was the big idea, they were simply told there was no future in that line anyway and they had better quit. They did. Now, the head of the factory may have had a fine idea that he would like some apprentices, but the foreman did not have the same idea.

Another instance occurred where a man was sent as an apprentice in a jewelry factory. His co-workers did not want any apprentices because it is easy to keep the price of labor up if you keep the supply down. They kidded him, they rattled him, they joshed him, they made fun of him, until his daily life became a burden, and he quit. Now the employer may say, "I took on an ex-service man, but he didn't want to work." But the employer did not know the innermost workings of his own factory.

We have taken these things up with various unions and they have expressed a desire to help us train these men. They are mostly beyond the ordinary age of apprentices, but the old system of apprenticing a man at 16 years of age has largely passed away and now with the intensive training and highly specialized methods a man can learn his trade in much shorter time than heretofore.

What Has Been Done

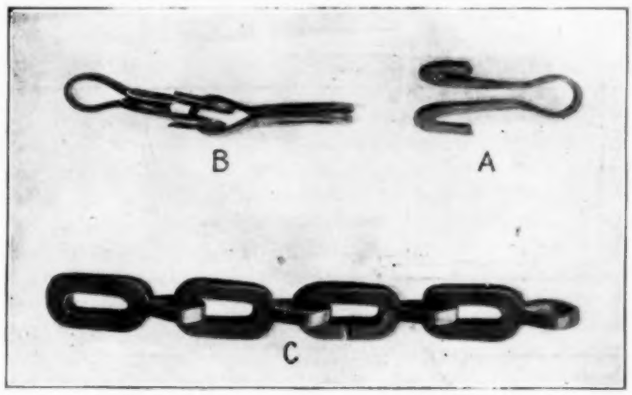
What we want are more opportunities for men to learn trades to get them out of the blind alley. We have already sent 1544 unskilled men to apprenticeships and we have induced 910 so-called clerks to change their vocation and learn a trade. This work must go on and to do it we need opportunities for men to learn things. The employer must not content himself with taking back his old employees. He must make new opportunities and send them in to us. I speak of the trades, but there are opportunities in other lines. Take a man on and teach him to be a salesman; teach him to be an executive; teach him your business and I know you will find the fighting blood will make good. All kinds went into the army and all kinds are coming out, and here and there you may have an unfortunate experience; but by and large, the men coming out are just a little better than they were when they went in.



Repairing a Safety-Link Chain

By D. C. Cook

The usual method of repairing or lengthening a safety-link chain is to splice the ends with wire. This, however, is not satisfactory from a strength or appearance standpoint and is undesirable where the splice happens to be in a place where the chain runs over a pulley.



REPAIRING A SAFETY LINK CHAIN

An efficient repair, which is approximately as strong as a solid chain, is shown in the accompanying illustration. A link is opened on opposite sides *A* and assembled as shown at *B*. After the link is closed the repaired chain *C* is ready for use. If so desired, the cuts in the repair link may be soldered or brazed, thus restoring the original strength of the chain.

Adapter for Lathe Chucks

By E. Amos

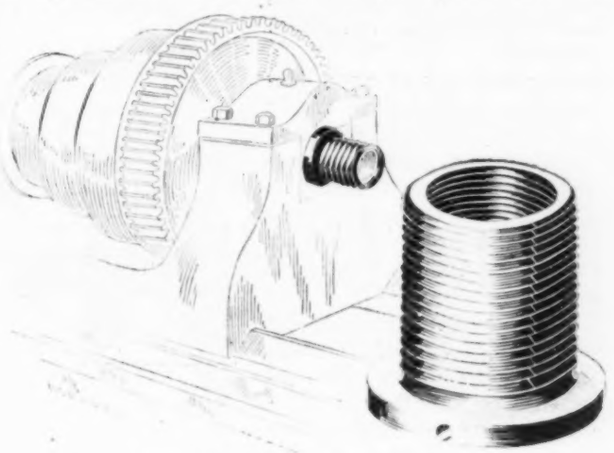
In most toolrooms and smaller shops, especially if they are of long standing, there is apt to be a variety of lathes each with a spindle nose of a size and pitch of thread "all its own."

Some of these lathes have chucks fitted to them and some do not, with the result that Bill may have to wait for a lathe that has the kind of chuck on it that he wants to use, while Tom may not be able to do his job because the chuck belonging to the only lathe he can get is "tied-up" with a half-finished job.

In two or three places that I have visited they have very comfortably arranged to meet this difficulty by making "adapters" for each lathe. The adapters are shouldered bushings of machinery steel, each fitted to its individual lathe spindle in respect to its inside diameter and thread, but all having a common outside diameter and thread.

The holding plate, backplate, or collar—whatever you choose to call it—of every chuck is fitted to the adapter, with the result that any chuck will go on any lathe that is big enough to swing it.

This is a great convenience and I can see no reason at all against it. The cost of making adapters is surely not to be considered, as this is a spare-time occupation for apprentices. Don't forget to put a small drill hole in the collar of each adapter, and make a spanner to fit it so that the adapter can be removed from lathe spindle or chuck, whichever it elects to remain with when the chuck is taken off.



ADAPTER FOR LATHE CHUCKS

A Homemade Annealing Fixture for Partly Finished Brass Pins

By Fred W. Stalker

The fixture shown in the illustration was designed to expedite the annealing operation on a large quantity of brass pins which had been finished as far as the swaging operation. Failure to get satisfactory results from the swaging die made necessary the addition of the expense of the annealing operation to salvage the lot of pins that had already been machined. This might have been unnecessary had it not been impossible to obtain any more stock of even as good quality as that already used up.

The material was hard-drawn brass wire which had a diameter of 0.081 in. The machining operations consisted of cutting off the pin, running it through a wire straightener and rounding off and slotting one

end in an automatic screw machine. A No. 70 hole was then drilled at right angles to the slot.

One controlling factor in the design of the annealing fixture was that not more than $\frac{5}{32}$ in. of the swaged end could be annealed without interfering with the proper functioning of the pin in its assembly.

As shown in the illustration a slider *C*, similar to a printer's stick, was used as a hopper to hold the pins *D*.

The filled hopper was clamped in the fixture by the knurled screw *P* bearing against the bracket *B*, the lowest pin dropping into the feed tube *N*. Two movements of the plunger *J* with its extension *H* loaded *N* with three pins, the first one projecting about $\frac{3}{8}$ in. from the end of the tube and $\frac{1}{4}$ in. into the flame of the burner *L*. When this pin has been sufficiently heated a movement of the plunger *J* to the left ejected it and allowed it to drop into the water can *K*. When the spring *G* had returned the plunger another pin dropped into the feed tube and the cycle was complete.

As speed was of some consequence two boys were put on the job, one to fill the three hoppers and the other to operate the fixture. After a little practice these boys were easily able to turn out an average of 7000 to 8000 pins daily.

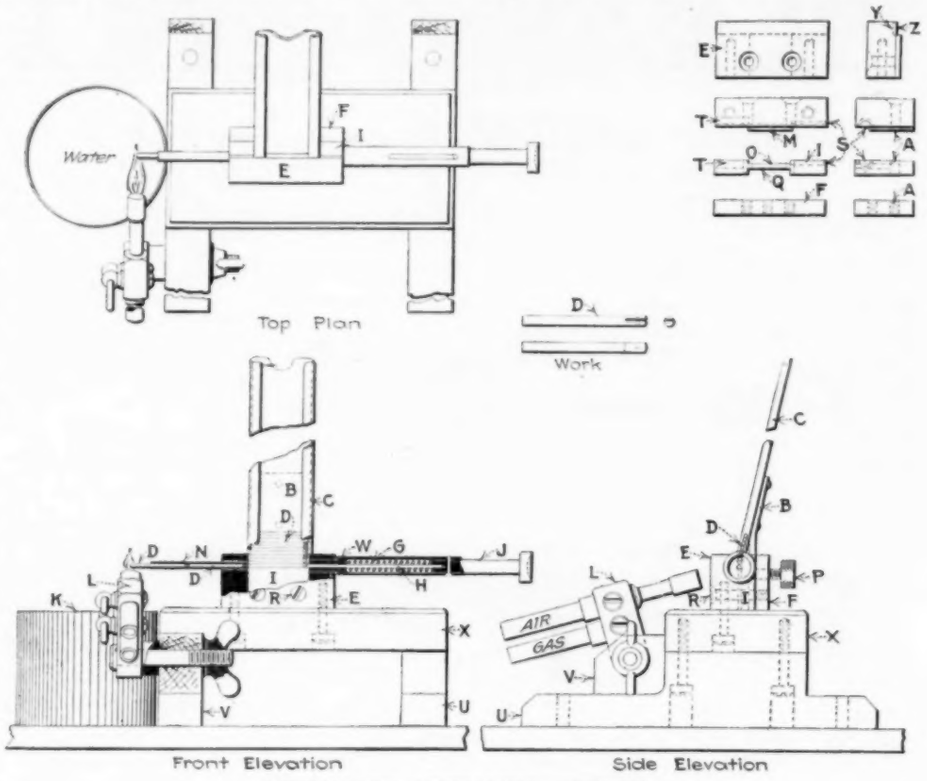
The hoppers *C* were made of No. 25 B. & S. sheet brass, the bracket *B* of $\frac{1}{4}$ x $\frac{3}{4}$-in. cold-rolled steel, the blocks *E*, *F* and *I* of cast iron and the tube *N* of $\frac{5}{32}$-in. outside diameter by $\frac{3}{32}$-in. stock brass tubing. The base *X* was a standard-finished shop casting and the supports *U* and V were of hard maple. The burner *L* was a slightly modified standard fixture.

The blocks *E*, *F* and *I* were made in section to simplify machining and facilitate assembly. The sequence of operations was as follows: All three pieces were clamped together and the holes *A* drilled, tapped and countersunk as shown in the figure. The three parts were then separated and *E* was milled to produce the tongue *M*.

The corner *Z* was then milled out, and the slots *O* and *Q* were then milled in *I*. *E* and *I* were next clamped together again with a 0.005-in. paper spacer between them, placed in centers and the holes *S* and *T*, located at the joint, drilled and reamed. *E* was then milled at *Y* to form one-half of the throat under the hopper.

When the fixture is assembled the screws *R* hold sleeve *W*, tube *N* and the three blocks *E*, *F* and *I* firmly together and the tongue *M* acts as a guide for the pins as they enter *N*, which is slightly belled to prevent the pins from jamming.

Experience showed that the water can *K* had to be emptied after every third or fourth hopper and refilled with cold water.



DETAILS OF ANNEALING FIXTURE

Turning, Hardening and Grinding a Long Boring Bar

By W. C. Spring

Recently I had to make a boring bar to be used in a line-boring jig for automobile-motor crank cases. This bar was of machine steel and about 4 ft. long, the contour being shown by the illustration. About 6 in. from either end there was to be a journal 6 in. long of larger diameter than the rest of the bar, to run in bearings in either side of the jig. These journals, in addition to serving the purpose their name implies, afforded greater rigidity to the bar while boring.

The jig was fitted with hardened and ground bushings to serve as bearings for the bar, and it necessarily followed that the journals on the boring bar should be hardened also, for it is obvious that were either surface not properly hardened, wear would result after a short time, rendering the whole outfit of little use. I was confronted with the problem of hardening the journals, yet leaving the middle and ends of the bar with the initial physical properties of machine steel for reasons to be made clear later in this article.

It was possible to make the whole bar to size, leaving about 0.020 in. for grinding on the journals, and then pack-harden the whole piece and grind the journals, but anyone with experience along this line knows that it is practically impossible to pack-harden a long piece without causing it to twist or warp, and when the attempt is made to straighten it the result is generally quite disastrous.

There are three ways in which such a job can be handled successfully: The first way is to turn the bar to size all over, leaving grinding stock on the journals; then copper plate the bar all over and with a

piece of emery cloth polish off all the copper plate on the places it is desired to harden. The piece may now be carbonized and hardened, and the bar will be found to be as soft and ductile as ever wherever the copper plate remained on, while the places where the plating was rubbed off are hardened as desired. This manner is impractical, however, for shops that lack copper-plating facilities.

The second way to handle such a job, if the bar is smaller on the ends than the journals, is to turn the bar straight, make two bushings from tool or machine steel the size of the journals plus grinding stock,

LONG BORING BAR WITH HARDENED JOURNALS

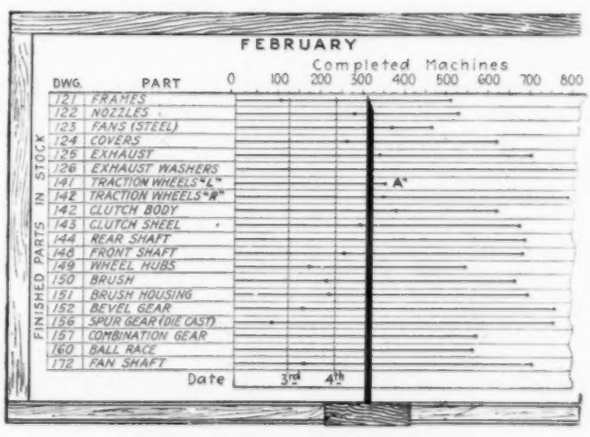
harden, and press them tightly on the straight bar; then place the bar on centers and grind the journals to size. Do not grind the bushings on the outside before pressing them on the bar, for the bar may become sprung in this latter operation, thus throwing the journals out of line.

The third way of performing the job is probably the cheapest, and in many cases the best one. Instead of turning the bar to size as in the first case, leave about $\frac{1}{16}$ in. of stock on the ends and in the middle, but turn the journals to grinding size as before. Then carbonize, but not harden, the whole bar; put it back in a lathe, and turn the ends and the middle to the proper size. It is now put in the furnace, heated to the proper temperature and hardened. The journals will be of proper hardness, while the remainder of the bar where the carbonizing was turned off will be as soft as before. If the bar springs or bends during the process of hardening, it can be easily straightened without fear of breaking it. Grind the journals and the bar is completed.

A Finished-Stock Control Board

By L. D. Peik
Cleveland, Ohio

Very often in the assembling of machined parts, some item is found to be out of stock, or is being shipped, or for lack of raw material is not machined, and perhaps it was an oversight on the part of the clerk. The result is a drop in the production curve.



THE STOCK CONTROL BOARD

After making considerable study of the perpetual inventory and stock cards on file, the writer devised a finished-stock control board as is here shown. This arrangement, however, does not in the least lessen the responsibility of the clerk making out the card records, but it does relieve the strain on the nerves of the production manager who expects to make good his promises.

Conditions appear more alive or vital when presented in this form than do a lot of figures and cards, and usually there is no one to check the stock clerk should he neglect to note a critical low stock balance. A low balance as shown on the board at *A* is sure to have the attention of the production man.

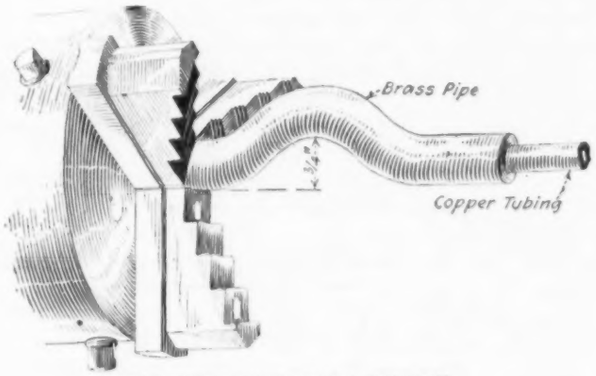
The indicator can be moved ahead to the figure representing the number of machines to be scheduled for a certain date and the stock balance can be subsequently noted directly.

A vertical line is drawn on the board each night showing the number of machines completed for the day. All deliveries of parts to the finished-stock room for the day are indicated by the extension of the horizontal lines.

Device for Straightening Copper Tubing

By H. G. W. Reichenbach

Recently a lot of small copper tubing came to our shop that instead of having been wound on spools as would ordinarily be the case, had been cut to lengths of about 20 ft. and to all appearances wound over the



THE STRAIGHTENING DEVICE

hand and elbow of the man who had dispatched it, much as a rigger coils up rope.

The tube, which was of about $\frac{3}{16}$ in. outside diameter, was full of kinks and curls that defied all ordinary means of straightening. All kinds of stunts were tried; we ran it through a hand rolling machine; we gave each piece a quick sharp pull, without effect—on the tubing; we cursed the fellow who wound it up, but even *that* did not get it straight.

After we had all agreed to give it up I remembered a device that I had seen in my apprentice days, and which I have since used with good results. It consists of a piece of brass pipe $\frac{1}{4}$ to $\frac{3}{8}$ in. in diameter, bent as shown in the sketch and held in a chuck on a speed lathe which has a hollow spindle.

The brass pipe need be no more than 6 or 8 in. long, and the bend should be about $\frac{3}{4}$ in. out of line.

With this device running at high speed we straightened the refractory tubing very neatly at the rate of about 20 ft. per minute.

Reminiscences from the Antipodes—Patenting a Gear Hobbing Device

By John Miles
Keilor, Australia

Being in a position to make a few experiments, I am always on the lookout for methods of getting out work that will result in a better product or lower cost of production. Not all of my experiments are successful, but occasionally one gets by and attracts quite a bit of attention locally.

I want to tell you of one such, in the way of an attachment to a milling machine for the purpose of hobbing gears. It involved no principles not well-known to mechanics of wide experience but evidently was new to some in this vicinity.

The attachment consisted of a pair of spiral gears of equal ratio; a flexible telescopic shaft; a casting to hold one gear, which bolted on the column of the milling machine; and a bracket, which was bolted to the machine bed behind the dividing head. Change wheels supplied with the machine were also used, as was the bracket for holding them. The other spiral gear was fitted to the machine arbor close up to the spindle nose.

The hobber sailed away merrily cutting 10 P. fiber gears having 24 teeth of 1 in. face, in three minutes.

Now we have some engineers around here who do not need to read the *American Machinist* for the reason that they already possess all the information it could give. I happened to show one of these brainy individuals one of the gears, and mentioned the time it took to cut it.

"Utter rot!" was the reply. "Why, you could not index 24 times in that time, much less cut any teeth."

I arranged an appointment and on time around came "Brains" smiling confidently.

"All ready?" Out comes the Ingersollometer; away goes the gear and hob. "Brains" got so close to the cutter I was afraid he might get caught. Machine stops; gear finished; time, 1 min. 50 sec.

"How's that?"

"Why you did no indexing at all," says "Brains."

"No," I responded, "but we got the teeth."

"Marvelous!"

Another spectator said, "Worth a fortune; how about a patent? Give you half share and patent round the world."

I explained that the device was not worth a patent as anyone having a number of gears to cut would prefer a hobbing machine. However, a provisional application was filed, and then came more demonstrations.

One day a large auto stopped at the door and out stepped a real magnate—fine flavored cigar aroma floats around the shop—diamonds gleam—machine starts to work, gold watch comes out—magnate's eyes also gleam.

"Something good!" he says. "I'll give you £250, pay all patent fees, and you shall have one-sixth of the total value. I have £60,000 to put behind it."

I explained the existence of hobbing machines but the magnate was "in the know" and the provisional agreement was signed that night.

The magnate started to talk and many spectators called to inspect the device, one bringing a hobbing-machine catalog in his pocket, and he condemned the whole affair.

The magnate raves, counsel confers, magnate pays check and leaves the attachment to anyone interested

After this, the hobbing attachment caused no sensation and the cast-iron bracket which held the spiral gear finished things off by breaking in two while cutting a bronze wormwheel with a fly cutter.

Using the Compound Rest for Accurate Tool Setting

By E. A. Dixie

On page 1080, Vol. 50, of the *American Machinist*, Joel Sundell gives an academically interesting and no doubt correct formula which enables one to use the compound rest to make "extremely minute adjustments" of the tool.

The trouble with kinks of this sort is that their writers so often start out with false assumptions. The placing of a "micrometer" dial on the end of a screw is no assurance that the screw itself is *micrometric*. I have in mind a lathe, on which I have done some very fair work, parts of which were *perhaps* within half a thousandth of the size called for. The crossfeed and compound-rest screws of this lathe were cut on a bolt cutter; I know, because I cut them.

I also know intimately a number of other lathes and am familiar with the way they are manufactured, but I do not know of any lathe builder who puts precision screws in compound rests. This reminds me that it takes a great deal more than a precise thread to make a precision screw. In making the extremely accurate screws used in the machines which cut the glass screens used in connection with the interferometer, the principal difficulty is not with the *thread* of the lead screw but with the *flange*, which takes the thrust of screw cutting. It has been found almost impossible to make this flange face and the face which it abuts true planes, accurately at right angles to the axis of the lead screw, which of course results in a "periodic" error, commonly called a "drunk" thread by mechanics, due to the cam action.

Even with the use of precision screws, it is *practically* impossible to work to the fourth decimal place, but Mr. Sundell tells us that with the compound rest set at 45 deg. a movement of one division on the micrometer dial "will advance the tool 0.00005 inch."

There are other conditions which make it impossible to work to such limits on a lathe. Even in modern concrete buildings, the operation of accurate lathes requires that there be practically constant temperature and the absence of shocks and jars due to the operation of power hammers and other machines which jolt the building and cause tremors and vibration.

The precision lathes in a certain department of a well-known firm would not produce uniform work because of an unknown cause. Finally, the cause was discovered to be vibration of the building due to the use of certain reciprocating machines and tools. The vibration was so slight that it went unnoticed and only its result, spoiled work, attracted attention and influenced investigation. The cure in this case was the placing of sheet-rubber cushions half an inch thick under the lathe feet, and the lathe now does fine work, but not to the fourth decimal.

If the practical man wants to remove "half a tenth" or even two or three "tenths" from a cylindrical piece in the lathe, he will either grind it or lap it off, and on flat work, either lapping or grinding will be employed by him to remove such small amounts of metal.

EDITORIALS

Give Him A Chance

THE attitude of some shops toward the discharged service man who wants a chance to make good is nothing short of scandalous. In another column we are publishing an appeal from the director of the Government reëmployment service in New York City which cites two examples of the treatment of these men. Coming from such a source, their authenticity is undoubted but that such things should happen seems incredible.

In one case the fault lies primarily with the workmen, in the other with the foreman, but behind each there appears an alarming lack of knowledge on the part of the employer of the conditions existing in his own shop.

We find it hard to believe that any group of American mechanics would so far resent the attempt of a discharged soldier to learn a trade by which to make a living that it would haze him out of the shop. But there are the facts. Remember that he wasn't asking any favors from any one, only a chance to learn so that he could do his part in the increased production which is the only solution of the H. C. of L. problem. When we consider that there were undoubtedly men in that group of hazers who had shirked their duty as citizens and Americans and managed to get into some well-paid form of war production work which exempted them from conscription, it makes their treatment of a man who was not a slacker and risked his life to prove it, all the more despicable.

Aside from the moral aspects of the case there is a very evident economic menace in this attitude. The freezing out of a producer naturally limits the volume of production just when every voice is raised in a cry for increasing it to the limit to make up the wastage of the war and restore prosperity. Swatting the profiteer is a very commendable proceeding but the results as they affect the cost of necessities are likely to be about as potent as the legal liquor of the dry amendment. When the premier of the British Empire uses his most compelling eloquence to urge on his people the importance of hard work as their only salvation and the same stand is taken by a governor of our own Federal Reserve Banks it is well to give heed. The manufacturers who get together to hold down production and maintain high prices can be dealt with by the attorney-general, but when exactly the same thing on a smaller scale is attempted by the workers it is manifestly up to the employer to know what is going on and step on it, hard.

We earnestly hope that every employer of labor will do his utmost for the men who have served their time in the service, for the majority deserve more than they are likely to get. The two cases cited, where the workers drove out a soldier apprentice and where the foreman effectually blocked the advancement of several men whom his employer had taken on under an apprenticeship scheme, show that the interest in these men should not end when they are put on the payroll but that their work should be followed up and precautions taken to see that they really get a fair chance.

What's Back of This Propaganda?

IT IS hard to camouflage a cabbage so that it will pass for a rose or to disguise limburger cheese as perfume. And it is equally hard to associate 100 per cent. Americanism with the unmistakably foreign accent, idiom and reasoning displayed in the following quotations:

" . . . the concern that manufactured so many things indispensable to the supply of war munitions (making automatic machine tools for art cap die gage hole jig jag nib nub rim ream slot slip slit slide snip screw tab top test terse tie tread trim tug tube zig zag, so on."

Or the following:

"Countries using coins of metric weight and measure decimally divided, exclusively metric postal union, metric units in electric industry, in science, liberty motor airplanes, BRIT-AM helium Zeps (science's wonder of the world war); endorsed by organized manufacturers, steel, tanners, furriers, canners, packers, growers, miners, grocers, fishers, recorders, writers, draftsmen, labor, *cookers*, waiters, shippers, traders, world advertisers and women, so on, so on."

The above come from propaganda pamphlets distributed by the World Trade Club of San Francisco, U. S. America, which is manifesting a most surprising desire to benefit (?) "U. S. America" and the "U. S. American President" and the "U. S. American Legislators" by forcing the compulsory adoption of the metric system.

The World Trade Club is flooding the country with propaganda and evidently is supplied with a plentiful war chest; abundantly more so than that which measures the revenue of the ordinary philanthropic movement. Some one is apparently vitally interested in causing America to adopt the metric system at this time. Who is it and why?

The original literature of the World Trade Club reeked with idioms and idiosyncrasies of language such as the above, which conclusively negatives its Anglo-Saxon origin. The *American Machinist* called attention to this on page 909, Vol. 50. As a result a writer was evidently employed who could speak English, and subsequent editions of this propaganda became more Americanized in tone while remaining as foreign as ever in purpose.

Many Americans have damned their cooks but no American ever calls a cook a "cooker."

Americans do not address their president as "Your Excellency." Here is the superscription on the return envelopes sent out with the World Trade Club metric propaganda as it appeared before they hired an English speaking editor:

U. S. American President
His Excellency WOODROW WILSON,
U. S. American Congress and Congressional Committees
on Weights, Measures & Coinage
Washington, D. C.
U. S. America

And here is the superscription as it appears today:

WOODROW WILSON
President of the United States of America
U. S. American Congress and Congressional Committees
on Weights, Measures and Coinage
Washington, D. C.
U. S. America

A wolf may put on sheep's clothing but if the wise man sees the wolf's ears sticking out he will get a gun.

The World Trade Club states that the compulsory adoption of the metric system will bring the millenium, "cut the shackles of mental slavery," "bring peace on earth good will to men," "make motors, engines and machines run like Swiss watches," "relieve the school child from brain fatigue," and "keep the world war won."

The compulsory adoption of the metric system with its consequent loss of billions of dollars worth of American mechanical standards would cripple every American machine shop and cause a financial and industrial panic such as we have never yet experienced. And the same thing would be true in Great Britain.

Who would benefit most by dislocating American and British industry at this time? Let's find out who and what is back of this propaganda.

E. L. Dunn to Edit Shop Equipment News Department

WE TAKE pleasure in announcing to our readers and to the builders of machine tools and machine-shop equipment, that Edward Lee Dunn has become an Associate Editor of the *American Machinist* and will take charge of our Shop Equipment News section.

Mr. Dunn is particularly qualified for this work. Starting in life as a practical machinist, he worked in such shops as the Allis-Chalmers Co., Montana Mining Co., Ltd., Union Pacific Railroad Shops, etc. Later he was erecting foreman, and next, factory superintendent of the Burdette-Rountree Manufacturing Co., of Chicago. For fourteen years previous to the war, Mr. Dunn was connected with the Standard Plunger Elevator Co. of Worcester, first as designing engineer, then as works manager and chief engineer, and finally as secretary. While with the Standard Plunger Elevator Co., Mr. Dunn developed many automatic machines and was granted twenty-five or more patents on practical constructions. Automatic elevators of his design are in operation in a large number of prominent buildings and hotels, including the New York Public Library.

In addition to his splendid practical knowledge of machine tools gained by this experience, Mr. Dunn has had during the past year and a half a most unusual opportunity to take a national viewpoint of the American machine-tool industry. During this time Mr. Dunn was employed by the Government as an expert, first in classifiying machine-tool data and locating machine tools for manufacturers who had Government contracts, and later with the Machine Tool Section of the Salvage Board.

The editors of the *American Machinist* expect through the acquisition of Mr. Dunn to materially extend the service of this journal to builders and users of machine tools. We bespeak for Mr. Dunn the same hearty cooperation that the tool-building and using fraternity has always extended to the *American Machinist*.

Selling Value of Improved Machinery

THERE is one factor more than any other which will control the sale of machinery during the coming decade. It is a factor that has always had much to say about how machinery sold but which has never before come into such prominence and power as to dwarf by comparison almost every other selling point. That factor is *production ability*.

Nowhere we believe is there a measure or record of the relationship of commodities or products produced by machinery as compared to those produced by hand labor. It is safe to say, however, that at least three-quarters of the things that civilized people consider necessary to life, wealth and the pursuit of happiness are machine made. It has not always been so, but during the last decade the machine as a production factor has been more important than the man.

Admitting this, the fact that the world's production is insufficient, that demand exceeds supply, is not so much an indication of labor shortage or inefficiency as it is of a shortage of machinery.

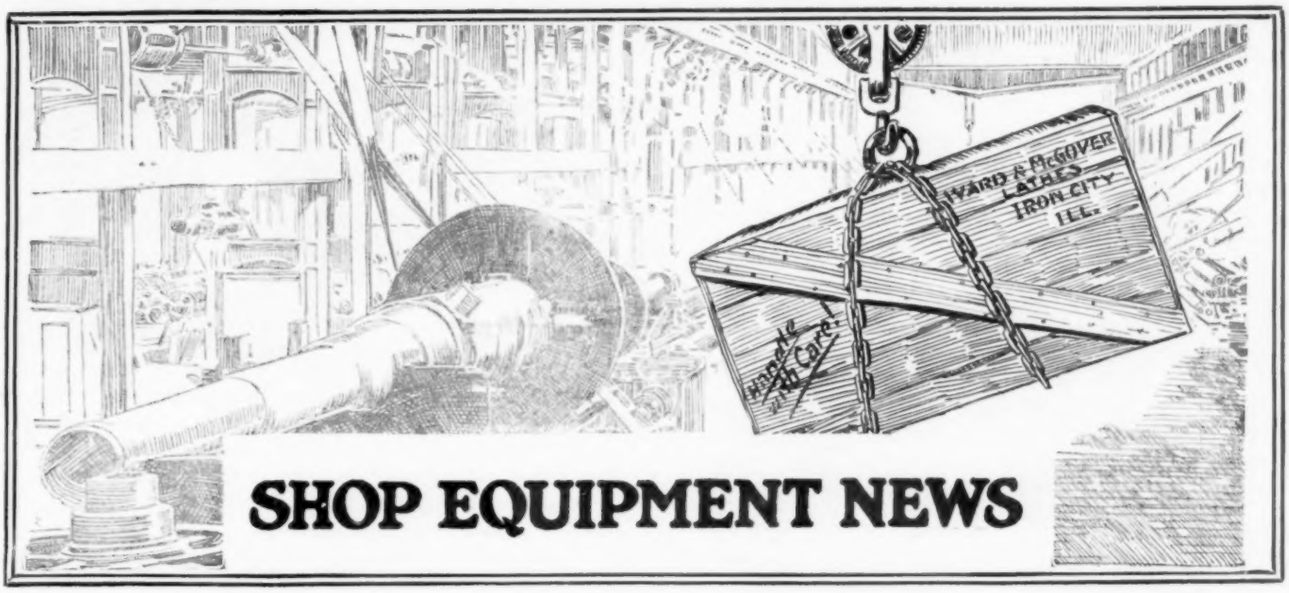
Another undetermined ratio is that between the relative productivity of the average man and the average machine. Nobody will ever be able to give us a figure covering this ratio, but there is one. During the past decade the increase and improvement in machinery was of such nature to keep the world comfortably supplied with manufactured products and commodities. Now this ratio no longer holds good. The machines that were needed to rebuild this world again must have a higher ratio of productivity than the ones that were used to keep it going before war's strain threw us out of balance.

Since the machine tool is the means by which all other labor-saving machinery is created, greater productivity in machine tools means more and better labor-saving machinery. It is a significant and very happy indication that never before in the history of the industry have so many vital improvements been made to machine tools as have occurred during the past eighteen months. It is an indication that the builders of machinery are awake to the responsibilities that lie before them—the task of getting the world back to normal through greater production.

The wise buyer of machinery is already awake to these needs. Before placing an order for a machine he asks, "How much greater productivity has this than the machine that you produced before the war?" An answer that conclusively proves that the builder has taken a forward step is the best selling point that can be produced.

Abolish This Incentive for Soldiering

IT IS unfortunate but nevertheless true that an increased rate of pay for overtime produces a tendency among some individuals to slacken regular work-period production, in order to take advantage of more lucrative overtime. The original purpose of an extra rate for overtime was to discourage an undue lengthening of the day's work. Under these conditions it no doubt served its purpose, but with the shorter hours that prevail today it happens not seldom that certain workers desire the extra hour—at the extra rate. It would be a good business proposition among manufacturers to cut out overtime even in view of our need for production. In the long run we would get more production.



SHOP EQUIPMENT NEWS

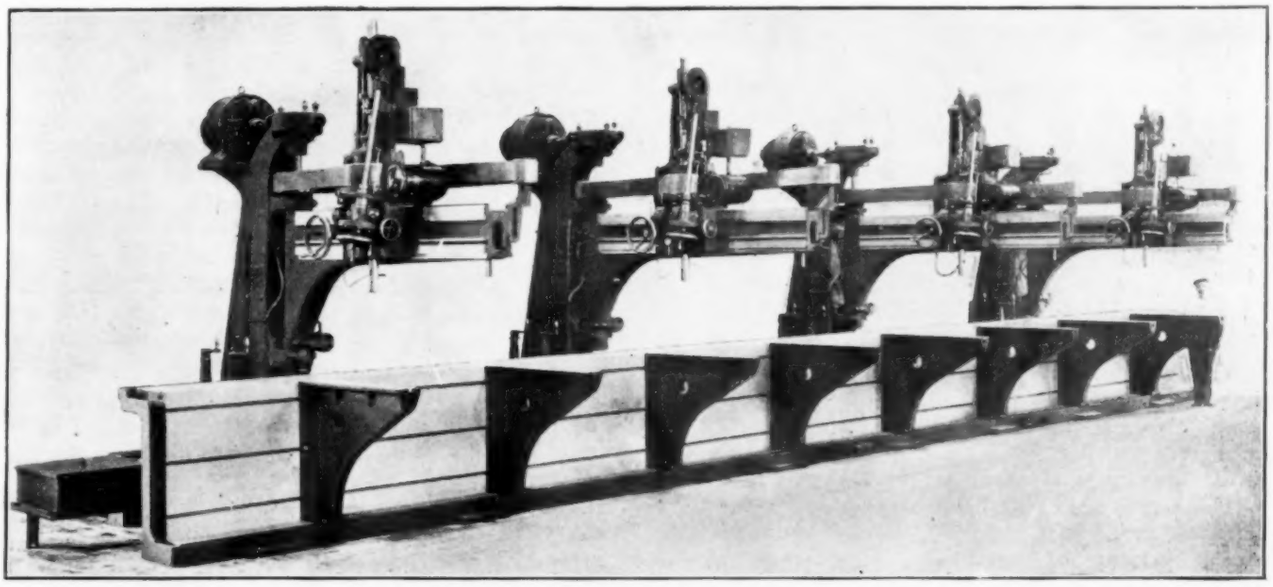
Niles-Bement-Pond Drilling Machine

The Bement-Miles Works of the Niles-Bement-Pond Co., Philadelphia, Penn., has recently brought out a multiple drilling machine for drilling the laminated steel-plate frames used on foreign locomotives. This machine, which is known as the multiple locomotive-plate-frame drilling machine, consists of a battery of four plain radial drilling machines, with arms fixed for height, which travel on a long bed. This consists of two sections placed end to end. The work table is mounted on the front of the bed and has both horizontal and vertical clamping surfaces and a trough cast around the same for collecting the coolant.

The length of the work table is 50 ft.; width of the top surface, 18 in.; height, 42 in.; and the lower or horizontal supporting surface, 8 in. wide. To the vertical working surface of the main table are attached eight heavy extension adjustable brackets 48 in. long which, together with the 18-in. top surface of the main table, gives a total working width of 5 ft., 6 in.

Each column is individually controlled by two handles. One of these engages or disengages the traverse screw nut, while the other is connected to the motor controller. Each drill arm is provided with a pneumatic clamping device which is controlled by a valve placed at the outer end of the arm so that the operator can make adjustments without changing his position. The spindle is of high-carbon steel, counter-weighted, and is driven by back gears located directly on the head and controlled by conveniently placed levers. The spindle is 3 in. in diameter its entire length and slides in a long sleeve which revolves in bushed bearings. This reduces the wear on the spindle to a minimum.

The general design of the machine permits the drilling of high work which otherwise would have to be clamped to the vertical surface of the main table or held by other means.



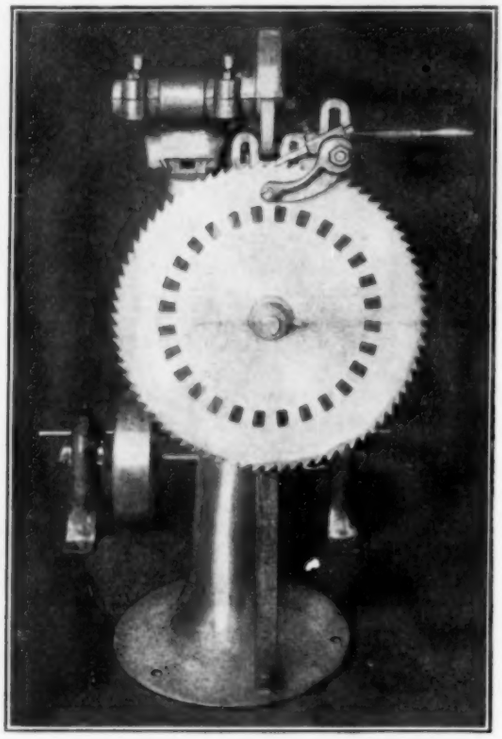
MULTIPLE LOCOMOTIVE-PLATE-FRAME DRILLING MACHINE

Maximum range of drill arms, all points on a plate 4 ft. 11 in. wide, 50 ft. long; minimum distance between end of spindle and top of work table, 18.5 in.; maximum, 36.5 in.; vertical traverse of spindle, 18 in.; horizontal traverse of saddles on their arms, 6 ft., 5 in.; six automatic feeds provided ranging from 0.0045 to 0.083 in. per revolution of spindle; each column is driven by an individual 10-hp. variable-speed d.c. motor which is geared to give spindle speeds from approximately 22 to 336 r.p.m.

"Simplex" Hand Feed Grinding and Beveling Machine for Cold Saws

The Earle Gear and Machine Co., Wayne Junction, Philadelphia, Penn., has recently redesigned and placed on the market its "Simplex" hand feed grinding and beveling machine for cold saws.

In the improved machine, the grinding head is mounted on dovetail ways which are protected from



THE SIMPLEX HAND FEED GRINDING AND BEVELING MACHINE

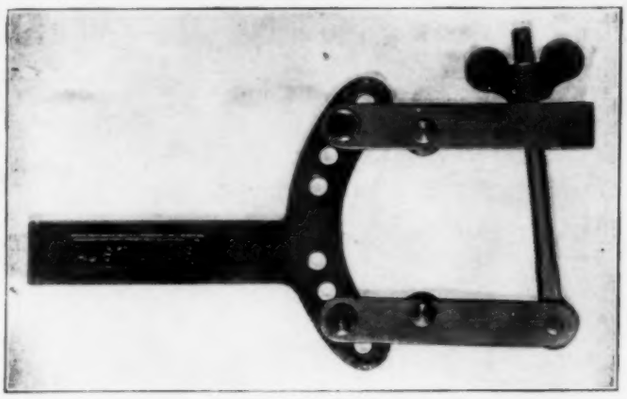
wheel dust and are adjustable for wear. The operating lever is made adjustable to suit the needs of the individual operator. The brackets, which carry the pressure screws, and the feed pawl are of sturdier and simpler design and adjustable to saws of various sizes. Many parts have also been eliminated.

The machine will take saws from 12 to 38 in. in diameter and uses a grinding wheel of 8-in. diameter, ¾-in. face and 1-in. arbor hole. It is driven by a countershaft, having a 6-in. diameter and 2¼-in. face pulley, at 765 r.p.m.

Austin Knurling Tool

The Austin Tool and Machine Co., Pittsburgh, Penn., is manufacturing the knurling tool shown, which is designed to make a full impression in any metal with a minimum amount of strain to the machine or the work.

The knurls are carried on hardened-steel pins in two parallel bars, which are fulcrumed at one end to the shank by means of knurled-head pins screwed into one part of the clevised end. The bars are brought together by means of an eye bolt and wing nut. The shank has several holes drilled to accommodate the different diameters to be knurled. By this method the pressure of



AUSTIN KNURLING TOOL

the knurls is directly in line through the piece to be knurled, the idea being to obviate the one-sided pressure on the lathe centers and work.

The shank is of the regular form which can be held in the ordinary toolpost, and is set at an angle so as to allow the knurling to be done close to a shoulder or the chuck. All parts are made of steel to withstand any strain they may be subjected to.

The No. 3 size has a shank ¾ x 1 1/16 in. and will knurl any size from 3/16-in. to 3-in. diameter. The No. 3 size is now ready for delivery; other sizes are under way.

Federal Self-Opening Die Head

The self-opening die head made by the Federal Products Corporation, 393 Harris Ave., Providence, R. I., is so made that ordinary button dies, procurable at almost any tool supply house, may be used instead of specially

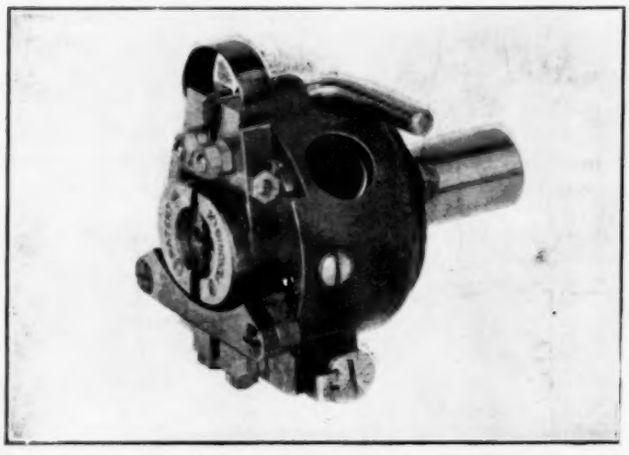


FIG. 1. FEDERAL SELF-OPENING DIE HEAD

made chasers. These button dies are split and the rough edges ground off at a slight angle, after which they are ready to insert in the die head shown in Fig. 1. Fig. 2 shows another view of the die head, the parts being disassembled.

The die head, as can be seen, is very simple in construction and can be cleaned in a minute or two without changing the adjustment. The die sectors are firmly held in the jaws and positively supported around their entire circumference so that they will cut a straight, full and accurate thread. Any thread within the range of button dies may be cut with this die head. The die may

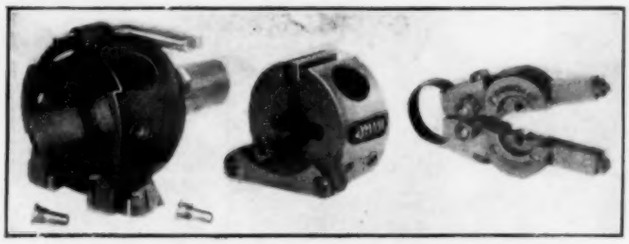


FIG. 2. DIE HEAD DISASSEMBLED

be closed by hand or by an automatic lever device when used in a turret lathe. The die holder may be used in the turrets of hand or automatic screw machines or in a lathe. All parts are made of alloy steel, carefully heat-treated and hardened.

Moline Vertical Gang Lathe

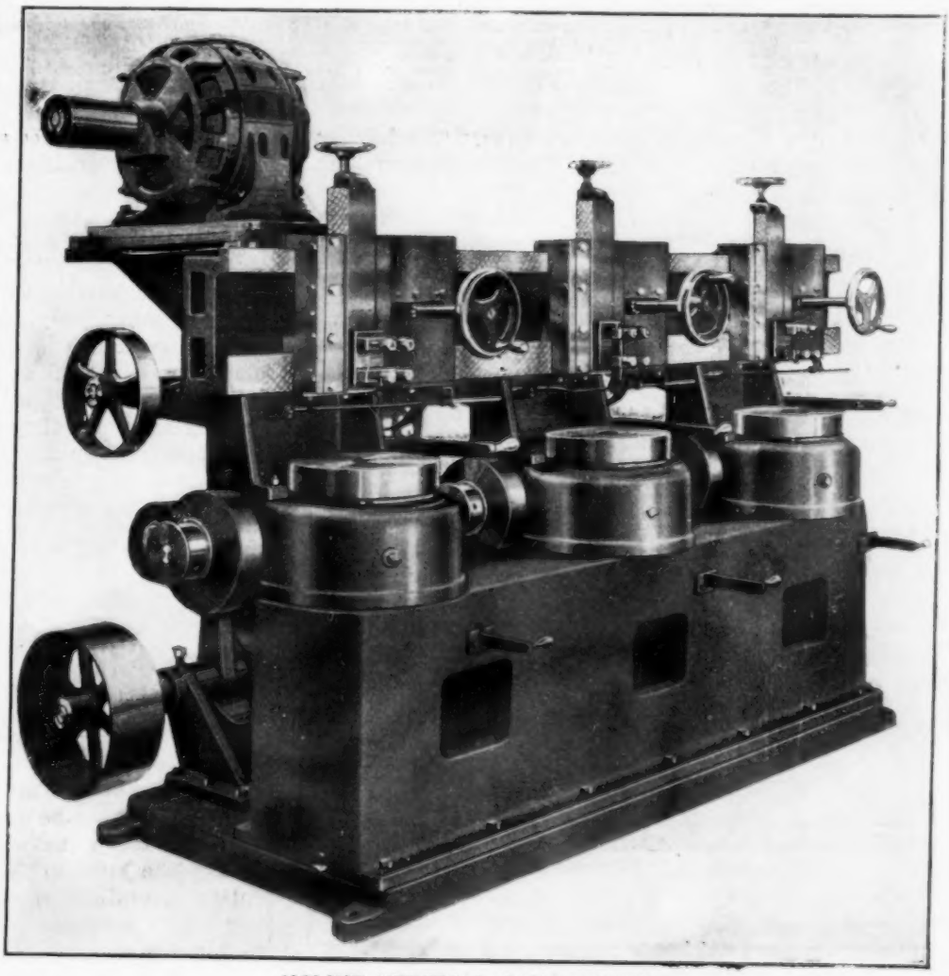
The Moline Machinery Co., Moline, Ill., has developed the vertical gang lathe shown. This machine was originally designed for the facing of pipe flanges but can be adapted to many uses. It is built in duplicate units, excepting the base, housing and rail, each duplicate unit having independent control of speed and feed.

Although the illustration shows only three units the machine can be built with any number desired, the larger number of units being recommended in a gang, as one man can handle all. The design is amply heavy to resist all normal stresses and absorb vibration.

The main drive is through a three-pitch hardened spiral pinion and bronze gear, giving a total reduction of 12 to 1 from driving shaft to table. A further reduction can be obtained from motor or countershaft to the driving shaft. The feed is through worm gearing, rack and pinion. The machine illustrated shows only a horizontal feed but it can be furnished with vertical and angular feed as well if desired.

The saddles are made with long narrow guides and so constructed as to best withstand the stresses of cutting. The rotating table is patterned after standard boring mill construction with a 90-deg. bevel, as well as a trunnion, bearing. Proper means of adjustment for wear are provided wherever necessary.

The principal dimensions are: Diameter of table, 13½ in.; actual swing, 16 in. travel of saddle on rail, 7 in.; vertical travel of tool head, 5 in.; height of table, 38 in.; distance between units, 36 in.; weight of three-unit machine, 8000 pounds.



MOLINE VERTICAL GANG LATHE

Baird-Detroit No. 4 Hand Screw Machine

The Baird-Detroit No. 4 screw machine made by the Baird Machine and Manufacturing Co., Detroit, Mich., is designed along recognized lines which permit of high production, all operating levers being so placed as to be within easy reach of the operator. All gears are cut from the solid with single-purpose cutters and are properly guarded. The head is cast integral with the bed, giving the greatest possible rigidity. The bearings are self-oiling, renewable and made of bronze, accurately machined and hand scraped to fit the spindle. The spindle is made from a high-carbon steel forging, bored from the solid, accurately machined all over and ground. Friction clutches are of semi-steel, exceptionally large in diameter; have wide bearing surfaces; engage and release quickly, and have independent adjustment.

The automatic chuck is forged solid on the end of the spindle and has a minimum amount of overhang. Work is gripped and released by a standard collet operated by a lever in conjunction with the stock feed so that work may be released, advanced and gripped without stopping the spindle. Extra capacity and master collets are furnished when desired at extra cost.

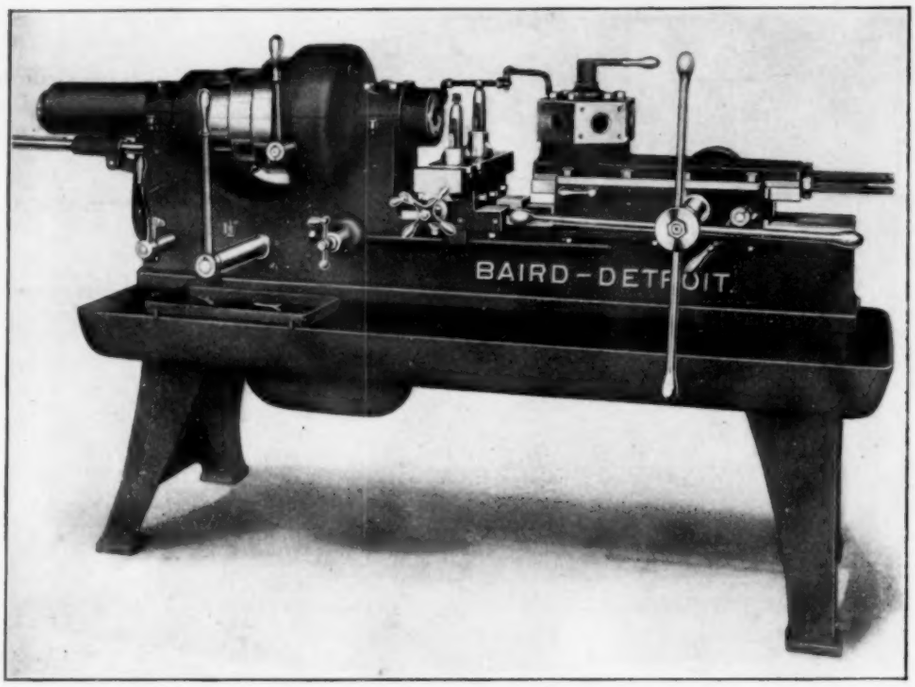
The turret is hexagonal in form, indexes automatically, is provided with six large tool holes and binder bushings and is tapped for securing large tools to the faces. Stock up to the full diameter of the hole can pass through the turret. The slide and saddle have

large bearing surfaces, are hand scraped and provided with taper gibs to compensate for wear and maintain alignment. Adjustable independent stops operate automatically with the revolving of the turret and trip the power feed. By means of a small lever a slight amount of overtravel can be obtained without disturbing any adjustment.

The power feed is positive, having four changes instantly obtainable by movement of a lever and can be changed while the machine is running. The cut-off rest is of the screw feed type having front and rear toolposts and is provided with hand longitudinal adjustment. A geared pump, attached to the back of the machine is driven from the countershaft and operates in either direction. The pan is provided with a large reservoir and has a strainer at the top.

A double friction countershaft is furnished. The clutches are of improved design, self-contained and can be adjusted without throwing off the belt. The pulleys have large bearing surfaces and ample provision is made for lubrication. The hanger boxes are wick oiling. A triple friction countershaft is furnished at extra cost.

Regular equipment includes: automatic chuck with one round collet, rod feed, two stock supports, cut-off rest, oil pan, pump and piping, tool tray, double friction countershaft and a set of wrenches.

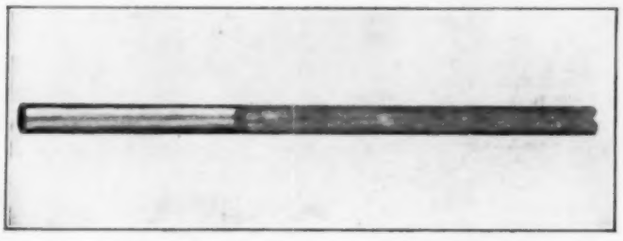


BAIRD-DETROIT NO. 4 HAND SCREW MACHINE

Principal dimensions: Automatic chuck capacity, 1¼ in. round, 1 1/16 in. square, 1 5/16 in. hexagon; size of hole through plunger, 1 5/16 in.; size of hole through spindle, 1⅝ in.; thread in spindle, 3⅜ in.; pitch of thread in spindle, 8 U. S. S.; length that can be turned, 9 in.; swing over bed, 18 in.; swing over cut-off, 8 in.; maximum distance end of spindle to turret face, 21 in.; center of turret hole to top of slide, 3½ in.; travel of cut-off (cross), 6¼ in.; travel of cut-off (longitudinal), 14½ in.; diameter of turret across faces, 8½ in.; diameter of holes in turret, 1½ in.; size of tapped holes in turret face, 7/16 in.; revolutions of spindle to feed 1 in., 24, 43, 73, 123; cone diameters, 12 in., 9¼ in., 7 in.; width of cone belt, 3 in.; diameter of countershaft pulleys, 12 in.; width of countershaft belt, 4 in.; speed of countershaft (r.p.m.), 240; open belt spindle speeds, 160, 265, 446; B. G. Spindle speeds, 35, 58, 97; capacity of pipe threads (brass), 2 in.; capacity of standard threads (machine steel), 1¼ in.; size of tools in cut-off, ½ in. x 1 in.; horsepower required, 2; floor space required, 28 in. x 82 in.; rod feed extension, 40 in.; net weight with countershaft, 2925 lb.; weight crated for domestic shipment, 3100 lb.; weight boxed for export, 3600 lb.; cubic measurement boxed (feet), 114.

"Raco" Covered Welding Wire

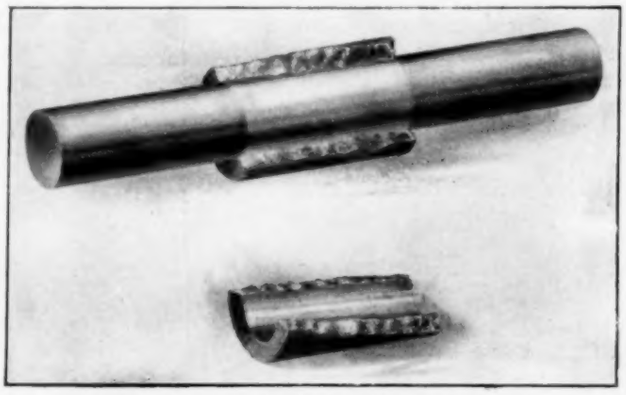
The Reid-Avery Co., 1436 Brandywine St., Philadelphia, Penn., has recently placed on the market a special covered electrode for electric-arc welding purposes, which is called the "Raco" covered welding wire. This electrode has been designed especially for electric-arc welding with alternating current, and it is claimed that by its use the weld is generally benefited, inasmuch as the coating or covering of the electrode melts with the metal, covering the weld with a light slag which acts as a flux and prevents oxidation. A steadier arc is also said to be obtained by use of this electrode which can be used with direct as well as alternating current. The rod can be furnished in different sizes to meet various demands.



A SECTION OF THE "RACO" COVERED WELDING WIRE

C. G. M. Oilless Bearings

The Massachusetts Oilless Bearings Co., Worcester, Mass., is now ready to produce its self-lubricating bearing in quantities. This bearing is known as the Cole Graphite Matrix or C. G. M. bearing and consists of an intimate mechanical mixture of graphite with any bearing metal alloy which has the requisite physical properties for the job in hand. This mixture is made possible by chemical treatment of the graphite which permits the proportion of graphite in the mixture to be varied at will.



C. G. M. OILLESS BEARING ON SHAFT

C. G. M. bearings are designed to run at a temperature of about 100 deg. F., those recommended for high-speed work having a greater proportion of graphite. Four different alloys have been prepared and tested to determine the coefficients of friction for each. The specimens were ½ in. in diameter inside and 1½ in. long, and under a load of 15 lb. and turning at 1600 r.p.m. they showed respective coefficients of friction of 0.015, 0.012, 0.0094 and 0.0062.

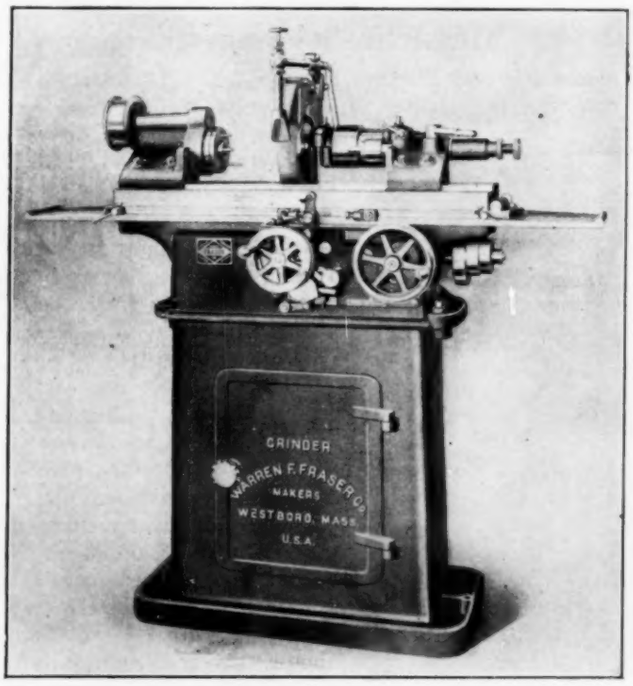
Another feature of the C. G. M. bearing is that it is not injuriously affected by lubricating oil as are some of the graphite insert types.

The illustration shows the action of the bearing. After a few turns the holes and scratches in the shaft which are present although invisible, fill up with graphite and both surfaces assume a mirror-like polish.

These bearings are not made in stock sizes but only to the customer's order. Being die-cast in special machines they are accurate to size and are so hard that they are very difficult to machine.

Fraser Plain Grinding Machine

The grinding machine shown is made by the Warren F. Fraser Co., Westboro, Mass., and is known as its No. 21 model. It has hand and automatic cross- and table-feeds, table adjustment for grinding tapers, overhanging table ends to protect the ways, adjustable wheel guard, pump and water piping. There is room in the base for the storage of tools and machine parts not in actual use. The machine may be driven by belt from a line shaft, or arranged for motor drive. It is built so as to occupy the smallest floor space possible for this type.

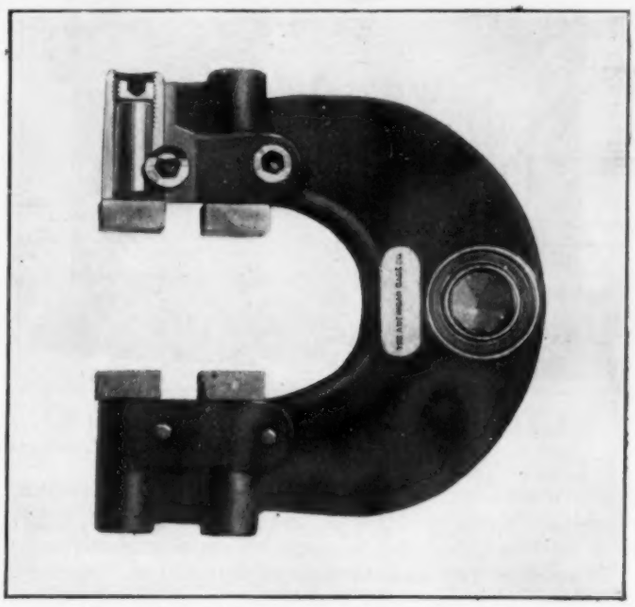


FRASER PLAIN GRINDING MACHINE

Specifications: Rated size, 5 x 18 in.; maximum capacity, 6 x 20 in.; swing over water guards, 5 in.; swing over table, 6¼ in.; centers No. 2 Morse taper; head and tailstock spindles, 1¼-in. diameter, hardened and ground; wheel, 12-in. diameter x 1½-in. face x 3-in. hole; wheel drive, 2½-in. belt on 4½-in. pulley; wheel spindle head bearing, 1⅞ x 4 in.; wheel spindle back bearing, 1⅞ x 3½ in.; wheel spindle, hardened and ground running in bronze boxes adjustable for wear; wheel speeds, 1800 and 2150 r.p.m.; work speeds, 30, 50, 75, 107, 150, 210 r.p.m.; table speeds, ⅜ in., ⅝ in., ⅞ in. per revolution of work; countershaft speed, 450 r.p.m.; tight and loose pulleys, 12 in. diameter x 3-in. face; power required, 3 horsepower.

American Adjustable Limit Snap Gage

This gage is made by the American Gage Co., Dayton, Ohio, in 21 sizes to give all dimensions from 0 to 12 in. The frame of this gage is an alloy casting so shaped as to give the maximum stiffness and strength.



AMERICAN ADJUSTABLE LIMIT SNAP-GAGE

The contact surfaces are glass hard and made square so as to permit getting close to a shoulder. The shanks carrying the square-headed contact-pieces are adjusted lengthwise by means of special headless setscrews. The shanks are also kept from turning and are locked in place by bevel-shouldered headless setscrews set in crosswise so that the bevel shoulder will engage a flat surface running lengthwise of the shank. The use of hexagon-socket headless setscrews makes it possible to adjust the gage with either a screwdriver or a special wrench furnished with the gage. Lead finger holds are provided on the frame to prevent the heat of the hand distorting the frame and to afford a good grip.

Pollock Crankshaft Milling Machines

Most automobile crankshafts are finished by either turning or grinding, but the Robert T. Pollock Co., Boston, Mass., has developed machines for doing this work by milling.

The machine, shown in Fig. 1, is a plain multi-spindle milling machine for machining the main bearings. It simultaneously mills all the main bearings concentric with the axis of the shaft. The number of spindles varies with the number of main bearings on the shaft to be machined

The milling of the crankpins is done in the machine shown in Fig. 2. This machine has four rotating heads and was built for machining a four-throw crankshaft. Any number of throws can be handled in this machine by the addition of the necessary number of heads. These heads are independent of each other and each rotates on its own axis and its axis is that of the individual pin which is to be milled by it. The rotation of the heads and cutters is accompanied by a unique driving arrangement, which consists of a gear box for

FIG. 1. POLLOCK CRANKSHAFT MAIN-BEARING MILLING MACHINE

delivering the power to the machine and a special gear combination which permits the driving of the heads and cutters either independent or simultaneously.

After the crankshaft has been clamped in the head and tailstocks and also placed in its proper position in relation to the heads, power is applied to the milling cutters, through the use of one of the levers shown in front. A steadyrest is clamped in position and serves to eliminate vibration in the shafts and the consequent chatter of the milling cut. The milling heads make one complete revolution. At the completion of this revolution, the feed is automatically disengaged and the machining of all the crankpins has been accomplished. The machines are of very rigid construction and are designed to meet all the requirements necessary in production machines. At a recent test and demonstration of the machines, the company reports that a four-throw Bugatti crankshaft was successfully milled in 9¼ min., floor to floor time. As this shaft is made of chrome-nickel steel, the machining time was necessarily considerably longer than it would be in the case of an ordinary openhearth carbon-steel shaft. Limits of 0.00175 in. plus or minus were maintained on each bearing. The life of cutters used is approximately 300 to 400 shafts and these cutters are inexpensive.

'Efficiency" Lathe Dog

The lathe dog shown is made by the Efficiency Device Corp., 199-203 Eighth St., Long Island City, N. Y. These dogs do not need a wrench of any kind to operate as they are simply opened, slipped over the work and the cam jaw is closed automatically by springs. These springs are only used to close the jaw and the grip is not dependent on them. The construction of the dog is such that the harder the pull, the tighter is the grip. These dogs are made of steel drop-forgings, heavily case-hardened and are made in five sizes which will handle anything from ½ to 3 in. in diameter, each dog having an automatic adjustment of ½ in.

"EFFICIENCY" LATHE DOG

Magnetic Sclerometer

Automatic and Electric Furnaces, Ltd., London, has a magnetic sclerometer for measuring the hardness of ferrous metals magnetically. The method is also suggested for determining the refining temperature of mild steel, the hardening temperatures of carbon and alloy steels and the requirements for correct normalizing and annealing. The method consists of subjecting a suitable rod, say 3 in. long by ½ in. in diameter, to the heat it is desired to investigate. It is then placed inside a standard magnetizing coil and direct current flashed on it. Magnetized to saturation, it is removed and placed in a small search coil connected to a Grassot flux meter. The reading obtained on the flux meter represents the magnetic hardness. The flux meter and the search coil used give readings in terms of Maxwell-turns and C. G. S. units of coercive force so that the results are in absolute international units.

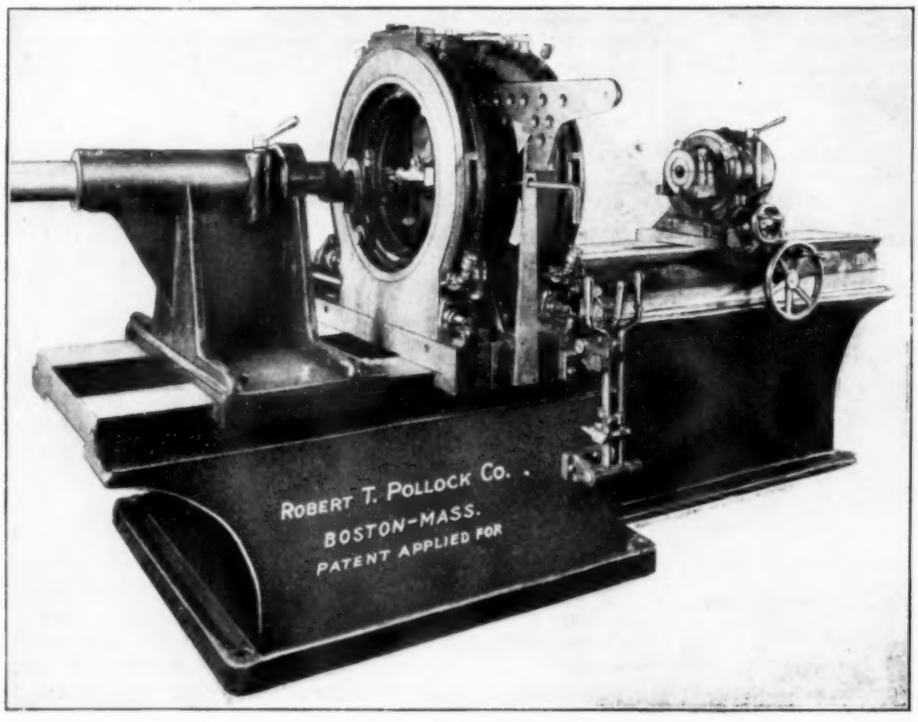


FIG. 2. POLLOCK CRANKPIN MILLING MACHINE

Program for the Convention of the American Steel Treaters' Society

(SEVENTH REGIMENT ARMORY, CHICAGO, ILL., SEPT. 23, 24, 25, 26, 27, 1919.)

At this time, it is difficult to make definite assignment of papers to be read at the different sessions of the convention. However, general subjects upon which papers will be presented have been decided upon. The following program will assist you in forming an opinion of the scope of the convention.

PROGRAM

TUESDAY, SEPT. 23, 1919

9 a.m. Registration, Seventh Regiment Armory.
Morning session—10 to 12 a.m.
10 a.m. Address of welcome: Hon. Harry H. Merrick, President of the Chicago Association of Commerce.
(2) Address of Welcome: Acting President T. E. Barker.
(3) Appointment of Tellers of Election.
(4) Report of Acting Board of Directors by Acting Secretary A. G. Henry.
(5) Report of Finance Committee: Acting Chairman A. F. Boissoneau.
(6) Paper: Relation of Heat-Treatment, Design and Selection of Steels for Metal-Cutting Tools to Factory Production: C. P. Berg, President, C. P. Berg & Co., Consulting Engineers.
Visit to Exhibits.
Afternoon Session—2 to 4:30 p.m.
Presiding Officer, Horace H. Clark, Chairman Chicago Chapter.
2 p.m. Reports of Tellers of Election.
Address of President-elect.
Papers: Heat-Treatment of Steels for Cutting Purposes.
Tuesday Evening—8 to 10 p.m.
Presiding Officer, G. Walter Esau, Chairman Milwaukee Chapter.
8 p.m. Papers: Case-Hardening in General.

WEDNESDAY, SEPT. 24, 1919

Morning Session—10 to 12 a.m.
Presiding Officer, David Bell, Chairman Buffalo Chapter.
10 a.m. Papers: Heat-Treatment of Miscellaneous Products.
Afternoon Session—2 to 4 p.m.
Presiding Officer, B. F. Weston, Chairman Pittsburgh Chapter.
2 p.m. Papers: Heat-Treatment of Steel for Intermittent Cutting Purposes.
Evening Session—8 to 10 p.m.
Presiding Officer, Geo. W. Pressell, Chairman Philadelphia Chapter.
8 p.m. Papers: Results of Investigation Pertaining to Heat-Treatment.

THURSDAY, SEPT. 25, 1919

Morning Session, 10 to 12 a.m.
Presiding Officer, W. S. Bidle, Chairman Cleveland Chapter.
10 a.m. Papers: Heat-Treating Equipment.
Afternoon Session—2 to 4:30 p.m.
Presiding Officer, Frank P. Fahy, Chairman New York Chapter.
2 p.m. Papers: Solution of Modern Demands on Heat-Treating.
Evening Session. 6:30 p.m. sharp.
Informal Banquet and Entertainment, Cameo Room, Morrison Hotel. Tickets, $3.

FRIDAY, SEPT. 26, 1919, 10 A.M. TO 10 P.M.

10 a.m. Exhibit at Seventh Regiment Armory. Plant visitation.
7 p.m. to 10 p.m. Band Concert—Third Regiment Military Band.

SATURDAY, SEPT. 27, 1919
"CHICAGO DAY"

Exhibition Open 10 a.m. to 10 p.m.
2 p.m. Band Concert—Third Regiment Military Band.
7 p.m. Band Concert—Third Regiment Military Band.

THE PAPERS

No one knows all about the heat-treatment of steel, and no one makes any claim. Investigations and progress are being made every day, and all should keep up with the advance of progress in this phase of manufacture. The list of papers in preparation follows:

A. W. Anderson, C. S. Gordon Co.—"Modern Pyrometry."
Cyril J. Atkinson, Laboratories, Milwaukee, Wis.—"Metallography of Steel."
G. A. Brewster, American Steel Foundries, Chicago, Ill.—"Annealing Large Sections of Cast Nickel Steel."
Shipley N. Brayshaw, London, England—"Salts for Quenching."
C. P. Berg, C. P. Berg & Co., Chicago, Ill.—"Relation of Heat-Treatment, Design and Selection of Steels for Metal-Cutting Tools to Factory Production."
Ray T. Bayless, James H. Herron Co., Cleveland, Ohio—"Results of Investigations Pertaining to Heat-Treating."
R. P. Brown, President Brown Instrument Co., Philadelphia, Penn.—"Pyrometry."
Alvin N. Conarroe, Chemist and Metallurgist, National Malleable Castings Co.—"Cast Steel."
E. F. Collins, General Electric Co.—"Electric Heating of Steel."
Wm. G. Conner, Geo. D. Whitcomb Manufacturing Co., Rochelle, Ill.—"Case-Hardening in General."
Arthur L. Collins, Atlas Ball Co., Philadelphia—"Heat-Treatment of Balls for Bearings."
D. R. Cornell, Standard Forgings Co., Indiana Harbor, Ind.—"Effects of Forging Temperatures on Heat-Treatment of Steels."
Wm. Geo. Dauncey, Associate Editor "Iron and Steel," Montreal, Canada—"Heat-Treatment of Cast Steel."
Jas. A. Doyle, New York City—(1) "The Function of Oil Burners in the Operation of Furnaces;" (2) "Factors to Be Considered in the Heating and Cooling of Steel."
C. W. Diemecke, Miehle Printing Press and Manufacturing Co., Chicago, Ill.—"Steels for Projectiles."
Chas. Eiser, Service Station Equipment Co., Chicago, Ill.—"Case-Hardening in General."
Charles P. Frey, Philadelphia, Penn.—"A New Compensated Heatmeter."
Frank P. Fahy, N. Y. C.—"Steel for Electrical Purposes."
Frederick J. Griffiths, Central Steel Co., Massillon, Ohio—"Results of Investigations Pertaining to Heat-Treating."
Arthur W. F. Green, John Illingsworth Steel Co., Philadelphia, Penn.—"Heat-Treatment of Rifle and Machine-Gun Barrels."
Fred Grotts, Holt Manufacturing Co., Peoria, Ill.—"Heat-Treatment of Cast Steel in Tractor Construction."
C. S. Gordon, Claude S. Gordon Co., Chicago, Ill.—(1) "Fuel Consumption and Its Waste, as Affected By the Proper Use of Pyrometers and Design of Furnaces;" (2) "Practical Applications of Pyrometers."
T. E. Gladden, Tindel-Norris Co.—"Submarine Crankshafts."
H. D. Gates, Pangborn Corporation, Hagerstown, Md.—"Sandblasting."
Wilfred Hanby, Rotherham, England—"Effect of Heat-Treatment and Mechanical Work on Physical Properties of Mild Steel."
N. B. Hoffman, Chief Chemist and Metallurgist, Colonial Steel Co., Pittsburgh, Penn.—"Heat-Treatment of Steels for Chisels."
Carl T. Hewitt, Fafnir Bearings Co.—"Heat-Treatment of Ball-Bearing Steel."
H. H. Harris, Swedish Crucible Steel Co.—"Controlling the Cost of Pots and Boxes."
Harry E. Hemstreet, Sheldon Axle and Spring Co., Wilkes-Barre, Penn.—"Heat-Treatment of Flat Spring Steel" or "Truck Axles and Parts."
L. E. Howard, Simonds Steel Co., Lockport, N. Y.—"Thin Armor Plate."
J. L. Harkness, L-W-F Engineering Co., Inc., New York—"Results of Various Heat-Treatments on Alloy Steels as Used in the Structural Parts of Aircraft.
Herman A. Holz, New York City—"Recent Developments in the Testing of Steel and Steel Products."
John H. Higgins, Camden Forge Co., Camden, N. J.—"An Investigation on Hot-Rolled and Forged Four-Inch Steel Bars."
S. C. Johnson, Pelton Steel Co., Milwaukee, Wis.—"Cast Steel and Its Heat-Treatment."
John J. Jones, of the Pressed Steel Car Co., Pittsburgh, Penn.—"Heat-Treatment of Tools for Alternate Contact."

Sparks from the

Resolutions of the United Engineering Society Relating to Andrew Carnegie

Andrew Carnegie's death on Aug. 11, 1919, at Lenox, Mass., brought to its close a career which greatly advanced all the engineering arts and sciences. By the introduction into the United States of the bessemer process for the production of steel and by the establishment and development of steel plants, which became the greatest in the world, he made available for engineers the most useful modern material for engineering construction. In the successful conduct of many industrial enterprises, he amassed great wealth, the possession of which he came to regard with deep seriousness as a public trusteeship. Mr. Carnegie devoted himself to the distribution of large portions of his fortune to projects for the benefit of mankind. He distributed his wealth not only in many directions, but also with the exercise of great wisdom based on careful investigation. His munificence provided large funds for the building of a home for the great national engineering societies and many associate societies. He was an honorary member of the American Institute of Mining and Metallurgical Engineers and American Society of Mechanical Engineers. He was personally known and loved by many engineers. In view of these facts, be it

Resolved, That the American Societies of Civil, Mining, Metallurgical, Mechanical and Electrical Engineers, the United Engineering Society and the Engineers' Club, herein express to the family of Mr. Carnegie and record their sincere appreciation of the great contributions of Andrew Carnegie to the advancement of engineering, and of his friendly assistance in making possible beautiful homes for the Engineering Societies and the Engineers' Club, thus fostering the spirit of unity in the profession.

* * *

International Machinery Exposition Announced

Announcement of the International Machinery Exposition to be held in Grand Central Palace, New York City, has been made by the Merchants and Manufacturers Exchange of New York. Oct. 15 is scheduled as the opening date at which time it is expected that hundreds of machines will be in actual operation on the floor. The exposition will occupy 50,000 sq.ft. of floor space, and will include a most comprehensive display of modern engines, lathes, milling, planing, drilling and screw-cutting machines, presses, can-making, woodturning machines, etc. The Merchants and Manufacturers Exchange will operate eight permanent industrial expositions in the Palace on the eight upper floors of the 12-story building. The four lower floors will be used for temporary exhibits such as the Annual Automobile Show, Motor Boat Show, Flower Show, etc.

Visitors at the International Machinery Exposition will find the other expositions in this building of considerable interest; included among them are the International Factory Appliance Exposition, International Mining Machinery Exposition, International Farm Tractor and Implement Exchange, and International Exposition of Mining Industries, etc.

Lloyd L. Warfield is manager of the machinery exposition and will be assisted by an able staff. Fred W. Payne is general manager of the Merchants and Manufacturers Exchange, and has general supervision of all of the expositions. Inquiries should be addressed prior to Sept. 15 to Suite 421, 405 Lexington Ave., New York City, and after that date to Grand Central Palace.

* * *

Britain Has 782 Ships Building

British shipbuilding experienced a rather healthy improvement during the second quarter of 1919, according to Lloyds Register, which showed that 782 vessels, of a gross tonnage of 2,524,050, were under construction. This was an increase of 269,000 tons on the amount under construction at the end of March and 709,000 tons more than the amount building a year ago. Records reveal that 181 vessels of 514,240 tons were launched during the last quarter, which compares with 72 vessels of 203,966 tons launched during the first three months of 1919.

* * *

American Locomotive Co.'s Orders

The American Locomotive Co., New York, reports export orders from Cuba, India, Japan, Formosa and Peru. Among these orders are: one Mogul type, 110,000 lb., to the Pesant Co., Cuba; one consolidation type, 97,000 lb., and 10 of 160,000 lb.; four switching, 130,000 lb., and two prairie type, 114,000 lb., to the United Railways, Havana, Cuba; one consolidation type, 125,000 lb., to the American Trading Co. of Cuba. An order came from the Tata Iron and Steel Co., India, for eight switching locomotives, 110,000 lb. Four prairie types, 90,000 lb., are ordered by the Imperial Karafuta government, Japan. The Taiwan Railways, Formosa, have ordered three consolidation type, 134,000 lb., and the Cerro de Pasco Railway, Peru, two consolidation type, 164,000 lb.

Government Soon to Make Armor Plate and Heavy Forgings

The new naval ordnance plant at South Charleston, W. Va., is now about to begin the manufacture of armor plate, and forgings for guns of large caliber--entirely new lines of work for Government plant. The South Charleston plant is a $19,000,000 enterprise, occupying more than 200 acres of land. It will be ready for making armor and heavy forgings as soon as the assembling of the necessary working force can be completed. Disturbed labor conditions incident to the war have been responsible for a delay in getting this work started. The new plant is equipped with every modern appliance for the manufacture of its specialties, and will turn out annually 50,000 tons of armor plate, guns, projectiles, and miscellaneous ordnance forgings.

Engineers, metallurgists, and mill and machine-shop men will be intertested in the positions which are to be filled in the supervisory and subordinate forces. The United States Civil Service Commission has announced for this plant the need of a superintendent of melting shops at $5000 a year, a superintendent of forge shops at $5000 a year, foremen of heat-treatment of armor plate at from $10 to $14.40 a day, foremen of heat-treatment of large guns at from $8 to $12.56 a day, foremen of 14,000-ton presses for armor and larger-caliber guns at from $11.84 to $13.28 a day, foremen of small guns at $8 a day, and foremen of heat-treatment of projectiles at $8 a day. Applicants for these positions will not be given scholastic tests in an examination room but will be rated on their training and experience, weighted at 90 per cent, and their physical ability, weighted at 10 per cent. Detailed information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of the local board of civil service examiners at the post office or customhouse in any of 3000 cities. Journeymen workmen and helpers should apply direct to the labor board at the South Charleston plant.

* * *

To Erect New Buildings

The officials of the Stanley Rule and Level Co., New Britain, Conn., report that a contract calling for the construction of two new factory buildings on Church St., near the Berlin railway branch, has been awarded to the B. H. Hibbard Co. One building will be three stories, while the other will be six stories high. The estimated cost of the erection is $35,000. The work will start at once.

World's Industrial Forge

By E.C.Porter, News Editor

Auto Makers Form New Organization

A $5,000,000 passenger car and truck company has been formed at Jackson, Mich. through the merger of the Jackson Motor and Manufacturing Co., Jackson Automobile Co., and the Four-Wheel Drive Truck Corp., of Chicago and Port Jefferson, L. I. The new company will be known as the Jackson Motors Corp. It will manufacture both cars and trucks, planning to produce during the next 12 months 4000 automobiles and 1200 four-wheel-drive trucks of 3½-ton capacity.

The concern will occupy the present plant of the Jackson Automobile Co., and will employ about 1000 men. The proposed passenger car to be turned out will be of the six-cylinder type. The company is now operating on a contract with the General Motors Corp. to finish 10,000 coupé and sedan bodies involving a production of 40 bodies daily.

The officers of the new organization are: President, H. A. Matthews, Jackson, Mich.; vice president, W. W. Sterling, Boston; secretary, Carl L. V. Exselsen, Chicago; treasurer, F. O. Evans, Chicago.

The machinery and all equipment of the Four-Wheel Drive Truck Corp. plants at Chicago and Long Island have been shipped to the Jackson Automobile plant. Both plants have been completely dismantled and Jackson, Mich., will be the main home of the organization.

The Jackson Automobile Co., discontinued the manufacture of its passenger car at the outbreak of the war and went into munition work. After the armstice the passenger car was not taken up, the company devoting itself to preparing for truck production only. The first completed machines will soon be placed on the market.

* * *

Car Production Was Unchanged in July

Production in Michigan and Ohio automobile factories during July shows but slight variation from June production. In some of the factories, such as Oakland, Saxon and Paige, production was less than during the previous month, owing to the completion of their present line and the commencement of work on new car series. The Ford Motor Co. was closed four days for inventory and for a few days prior to closing full production of 3000 cars daily was not maintained.

Counterbalancing these cuts, however, is Willys-Overland production that averaged better than 200 cars in July. This company did not produce a single machine in June owing to the strike which has been on for three months and which is still in effect.

Now that most of the factories have started production on their new car series, coupled with great improvement in the labor and material situations, the month of August should see new production records attained. Detroit was remarkably free from labor disturbances throughout July. Although the L. A. Young Industries, the Timken-Detroit Axle Co., and a number of foundries have men on strike, these plants are rapidly nearing normal production.

Material is now coming through freely and in greater quantities.

During July, 33 factories in the two states ran a daily average of 6784 cars. During June, 6649 cars were turned out daily by the same companies.

* * *

Canadian Airplane Company

A Canadian charter has been issued to Handley-Page, Limited, capital stock $2,500,000, with head offices at Morrisburg, Ont., permitting the company "to purchase, own, lease, manufacture, build, construct, erect or otherwise acquire, let, hire, charter and operate, deal and traffic in aëroplanes of all kinds, including monoplanes, biplanes, hydroplanes, flying boats, seaplanes, aircrafts and other machines, contrivances and devices, to navigate the air and useful for all air service, commercial, civil, naval and military," and to carry on a general aircraft business.

* * *

Sales of Surplus War Materials

The Director of Sales announces that sales of surplus war materials reported during the week ended Aug. 8, show a sharp increase over recent reports for similar periods. The aggregate for the week was $27,499,515. Reports received between Jan. 1 and Aug. 8 of the receipts of sales of surplus materials which had been cleared through the Office of the Director of Sales total $391,229,119. Prior to the establishment of the Office of the Director of Sales, the War Department had realized $123,245,240 from the sale of war materials, as was shown by a report made to Congress on Dec. 2, 1918. This sum, added to the sales cleared through the Office of the Director of Sales, makes the grand total of receipts from the sale of war materials reported as of Aug. 8, $514,474,359.

The report from the Ordnance Department totaling $1,572,247, included sales of non-ferrous metals at $666,958 and ferrous metals at more than $500,000.

Trade Currents from Cleveland and Chicago Districts

CLEVELAND LETTER

Approach of the fall period and the waning of summer, bringing marked restoration of confidence, is the keynote to the machinery market in the northern Ohio district as the end of August comes to hand. The outstanding feature in latest business is that while no sensationally large orders have developed, or are even pending, there is a large increase in the number of smaller orders, in most instances for one or two or three machines of the same or different kinds, coming into manufacturing and distributing houses in the Cleveland territory. This is looked upon by older heads in the business as a real indication of a return to truly normal conditions, and as a promise for steady improvement during the active season now close at hand. It is further borne out by the fact that August as a whole shows about twice as much business as July. This development also is taken to indicate that the rank and file of manufacturing business needing machinery and equipment no longer are waiting for "something to happen," and it is also more satisfactory to the machinery industry itself, in that the so-called sensational orders for large quantities of equipment would only mean that such firms placing orders are busy, while others are not. Machinery interests here prefer that the same amount of business is distributed by a larger number of firms, as proof that all business is on the upgrade.

While most of this business is being placed by Central West interests, a goodly proportion of the latest orders have come from all parts of the country, although this last can be cared for by only a few firms here, as most Cleveland interests confine their activities now to Ohio and the states bordering upon Ohio. While demand has been general, with perhaps a slight falling off from the automobile-making trade, there is a marked interest now, for no particular reason, for punch presses and lathes.

Added to domestic business being placed here is the steady inquiry, pretty generally followed by orders, from foreign countries. The outstanding feature of the week is the placing here of an order that will total about $25,000 for machinery. This business comes from Campania, Roumania, and the equipment will be required for machine shops in connection with oil-well work in that locality.

One indication of the demand for raw materials here is the plans of the Merchant and Evans Co. to increase its local warehouse facilities. This firm has been contemplating building a new

plant here, but has been held up by building material shortage and other unlooked for conditions. It has acquired the building at 410 Champlain Ave., which will be known as Warehouse No. 2. The addition of this plant will give the firm a capacity for 100 per cent. increase in stock, according to J. C. McElrey, district manager.

In keeping with the general movement for reduction in the cost of foodstuffs, and as part of the general program of manufacturing industries here to promote the welfare of employees, many firms have organized a cöoperative food-buying movement during the last week. The purchases are being made either through the factory managements, or through welfare associations in the factories. In some, stores have been established; in others large quantities of food are purchased at reduced prices and sold to employees at cost.

Some of the firms that have joined the movement in the last few days are the National Lamp Works, the National Carbon Co., the White Meter Co., the Hydraulic Pressed Steel Co., the American Multigraph Co., the Cleveland Hardware Co., the Cleveland Twist Drill Co., the Peerless Motor Car Co. and the Willard Storage Battery Co.

Chicago Letter

Business among the machinery dealers seems to be getting a little spotty, with handlers of lines of new machinery who can make prompt deliveries getting the best of the business. The long lists of second-hand tools offered for sale all over the country, particularly in the East, are having the effect of showing up dealers' sales in this class. This is not true, however, of lathes, and punch presses, the latter item particularly being in heavy demand. Sales of new stuff continue at the high pace set some weeks ago under practically the same conditions; large corporations buying nothing, but small consumers buying so steadily as to offset the big fellows' conservancy.

Last week, Chicago was visited by the Belgian committee from the Construction Metallique, headed by M. P. V. Jeanjean, director, the party being under the guidance of Lieut. E. B. Sykes, of the office of the Director of Sales, U. S. A. This committee viewed the millions of dollars worth of Government-owned machinery at the Symington Corporation's shell-making plant, with a view to making extensive purchases for shipment to Belgium. When final disposition of this vast quantity of machines is announced it should have the effect of removing a menace from the machinery business. So long as they are in Government hands and undisposed of, the possibility of their being placed on the home market will exist in the minds of both dealers and manufacturers.

Confidence in the ultimate development of machinery trade in the next year or two is evidenced by the action of one of Chicago's large second-hand machinery men in buying a great quantity of lathes during the past three months. To date, over 800 of the tools have been placed in the warehouse and these are but a small amount of his total purchases. They embrace different sizes of all standard makes, there being many lots of 20 or 30 or even more of identical size and equipment. They will be put in first-class condition in the dealer's own shop and placed on the market whenever conditions seem to justify.

Industrial unrest continues and, in spite of excellent present business, is a source of worry. There is not much doubt but what it is the cause of the big corporations keeping out of the market.

As all classes of machinery users are busier than ever before, however, any serious slump seems far off. Makers of phonographs, sewing machines, washing machines, automobiles and almost every other conceivable line are crowded with orders and are buying tools, and it is hard to figure labor troubles striking all these widely diversified classes of industry simultaneously; hence, for the time, at least, pessimistic prophets are not getting much hearing.

New Publications

Airplane Design and Construction. By Ottorino Pomilio, Consulting Aëronautical Engineer for the Pomilio Brothers Corporation. Four hundred and three 6 x 9-in. pages, with numerous illustrations and diagrams. Published by the McGraw-Hill Book Co., Inc., 239 West 39th St., New York City. Hill Publishing Co., Ltd., 6-8 Bouverie St., E. C., London. Price, $5.

The reputation of the Pomilio Brothers Corporation as airplane designers and constructors is so well established that a treatise by their consulting engineer should take rank as an authority on airplane construction. In this volume the subject is divided into four parts; the first three being included under the general heading, "Structure of the Airplane," and the remaining one under "Design of the Airplane." The text is so arranged that it can be adapted to either elementary or advanced college courses in airplane design. For the airplane engineer the fourth part, on design, should prove a valuable reference and time-saver, as it is replete with tables and diagrams. Unfortunately, the space devoted to the very important subject of testing is far too brief. Mr. Pomilio should have secured as a collaborator some one of our engineers who is used to technical writing, as in some places the literal translations of Italian technical descriptions make rather unusual and even ambiguous English.

Abrasives and Abrasive Wheels. By Fred B. Jacobs. Three hundred and twenty 5 x 8¼-in. pages and 174 illustrations with portrait of the author. Published by the Norman W. Henley Publishing Co., 2 West 45th St., New York. Price, $3.

This book has 21 chapters; two of which are devoted to the history of natural and artificial abrasives, and three to the manufacture of grinding wheels and sharpening stones, together with their grits and grades. Some of the other chapters cover such subjects as: Testing Wheels for Efficiency; Truing Devices for Grinding Wheels; Suggestions in Ordering Grinding Wheels; Design of Dust-Collecting Systems; Safe-Guarding Grinding Wheels; Abrasive Paper and Cloth; Surface, Cylindrical, Internal and Special Grinding. While some of the illustrations in this book could be better, the information contained is valuable to operators of grinding machines, especially the reasons given why wheels of various grits, grains and bonds should be used on certain classes of work.

Business Items

Machinery Merchants, Inc., 50 Church St., New York City, makes the announcement that in order to eliminate the confusion which the present name of the company invites, it will hereafter be known as Morey & Co. There has been no change made in the personnel of the company.

A distributing center for Hart-Parr tractors has been opened at Dallas, Tex., known as the Texas Hart-Parr Co., with Texas and southern Oklahoma as the territory. It is in charge of A. H. Grover and B. Synder.

Edgar T. Ward's Sons Co., importers of steel, 646 Washington Boulevard, Chicago, Ill., has opened a new warehouse at 660 West Fort St., Detroit, Mich. W. T. Reulman will be in charge of the Detroit office and warehouse.

The Sun Machinery Co. announces the opening of show and sales rooms at 278 Washington St., Newark, N. J., where they will carry a complete line of new and used modern metal-working machinery and industrial equipment of all description.

Forthcoming Meetings

American Foundrymen's Association. Annual convention and exhibit will be held in Philadelphia the week of Sept. 29, 1919. C. E. Hoyt, secretary, 111 W. Monroe St., Chicago, Ill.

The American Steel Treaters' Society will hold its annual convention and exhibition at the Seventh Regiment Armory, Chicago, Ill., Sept. 22 to 27. Al. J. Murphy, 154 East Erie St., Chicago, Ill., is chairman of the exhibit committee.

Boston Branch, National Metal Trades Association. Monthly meeting on first Wednesday of the odd months. George D. Berry, secretary, room 50-51, 166 Devonshire St., Boston, Mass.

Electric Hoist Manufacturers' Association. Monthly meeting at the offices of the Yale & Towne Manufacturing Co., 9 East 40th St., New York City. Secretary W. C. Briggs, Shepard Electric Crane and Hoist Co.

Engineers' Club of Philadelphia. Regular meeting the third Tuesday of the month, with the exception of July and August. Lewis H. Kenney is the chairman of committee on papers.

Engineers' Society of Western Pennsylvania. Monthly meeting, third Tuesday; section meeting, first Tuesday. Elmer K. Hiles, secretary, Oliver Building, Pittsburgh, Penn.

International Railway General Foremen's Association will hold its annual convention Sept. 2 to 5 inclusive, at the Hotel Sherman, Chicago, Ill.

Philadelphia Foundrymen's Association. Meeting first Wednesday of each month. Manufacturers' Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45, North Philadelphia, Penn.

Rochester Society of Technical Draftsmen. Monthly meeting last Thursday. O. L. Angevine, Jr., secretary, 547 Arnett Boulevard, Rochester, N. Y.

The National Safety Council will hold its eighth annual Safety Congress in Cleveland, Oct. 1 to 4.

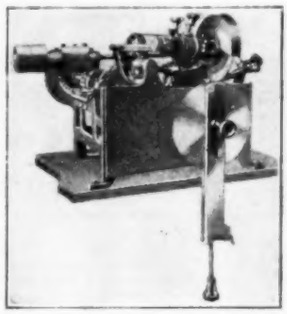
Condensed-Clipping Index of Equipment

Clip, paste on 3 x 5-in. cards and file as desired

Grinding Machine, Saw

Wardwell Manufacturing Co., 110 Hamilton Ave., Cleveland, Ohio.

"American Machinist," July 31, 1919.



The saw-grinding machine illustrated is known as the company's model E; is supplied in either bench or floor type, and is designed for sharpening screw-slotting saws, slitting saws and cold saws ranging from 1½ to 18 in. in diameter, with teeth varying in size from 36 to the inch to 2 in. from point to point. The saws can be sharpened, the action being entirely automatic, at a speed of 45 teeth per minute. A scaled slotted eccentric permits of quick adjustment of the feed, and a double-pawl positive-feed movement gives a continuous feed to the saw, even when teeth are broken away. The machine can be furnished for either belt or motor drive, as desired.

Die Heads, Self-Opening, "Victor"

Victor Tool Co., Waynesboro, Penn.

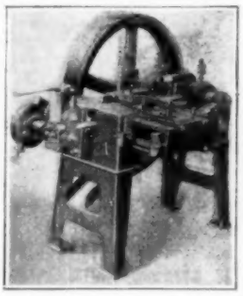
"American Machinist," Aug. 7, 1919

The chasers are held in individual plungers having a 14½-deg. angle by a slot fitting into a tongue milled in the plunger. The plungers are held in a scroll ring or collar and the die heads are automatically opened as soon as the travel of the turret is stopped. The heads can be also opened at any point by retarding the travel of the turret slide by the handle shown. The heads are adjustable through a range of ⅛ in. and are graduated to indicate the proper adjustment. A roughing and finishing attachment operated by a small lever is fitted. Right- or left-hand threads of standard or special pitches can be cut and standard heads will cut to within ¼ in. of a shoulder.

Heading Machine, ½-in., Solid-Die, Single-Stroke

Kent Machine Co., Kent, Ohio.

"American Machinist," Aug. 7, 1919

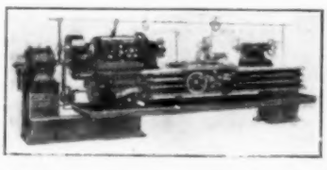


The principal features of this machine include a scotch yoke mechanism with solid-wedge adjustment; a heavy-duty cut-off device; an accurate and flexible friction feed; convenience of assembling or disassembling for repair and inspection; and small floor space. The friction feed consists of two grooved feed rolls actuated by a friction device with which a feed stop finger is provided to care for any over-feed setting. The length of feed is regulated and controlled by the knobs projecting from the lower part of the feed disk at the left. The feed may be instantly thrown out of action by a one-eighth turn of the lever located on top of the feed roll support.

Lathe, Manufacturing with Ball-Bearing Cone

Flather Manufacturing Co., Nashua, N. H.

"American Machinist," Aug. 7 and 21, 1919

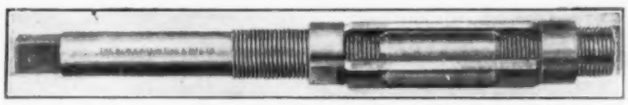


This 7-in. lathe has a swing over ways, approximately 8 in.; distance between centers, 15 in.; length of bed, 36 in.; hole through spindle, ⅝ in.; maximum capacity of draw-in collet chucks, ½ in.; taper in front end of spindle, Morse No. 3; width of belt, 1¼ in.; spindle bearings, bronze; cone bearings, ball type; back gear ratio, 7:1; lead screw, ⅝ in. in diameter, with 10 acme threads; travel of cross-slide, 4½ in.; travel of compound rest, 1½ in.; countershaft, two-speed, double-friction type; weight of bench type machine, 300 lb.; weight of floor type machine with pan, 400 lb.; floor space, 24 x 42 in.

Expansion Reamers

New Britain Tool and Manufacturing Co., New Britain, Conn.

"American Machinist," Aug. 7, 1919

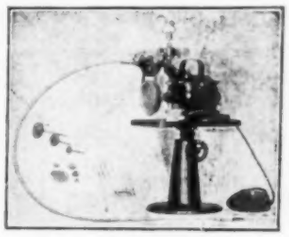


These expansion reamers are made in sizes from ½ to 4½ in. in diameter. They consist of three parts: body, adjusting nuts, and blades. The blades are tapered and beveled at each end and the adjustment is made by moving the blades up or down in the taper grooves cut in the body. Either five or six blades are fitted, the six-blade reamers having the blades unevenly spaced to prevent chattering. Blades can be furnished in either carbon or high-speed steel.

Die-Sinker's Grinding Outfit

R. G. Hastings Co., 547 West Washington Blvd., Chicago, Ill.

"American Machinist," Aug. 7, 1919



The ¼-hp. electric motor is mounted on an adjustable base so that it can be raised, lowered or swung around to any desired position. The motor runs at 1800 r.p.m. and drives the countershaft at either 4000 or 6000 r.p.m. The countershaft can be either raised or lowered to adjust the belt tension and is directly connected with the flexible shaft which drives the chuck holding the tool arbor. The tools consist of small grinding wheels and burrs of various shapes and sizes, as well as small high-speed steel burrs or milling cutters.

Grinding Stands

St. Louis Machine Tool Co., 932 Loughborough Ave., St. Louis, Mo.

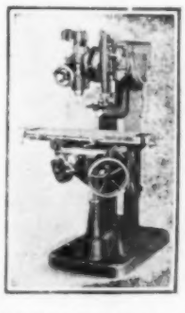
"American Machinist," Aug. 7, 1919

Made in three sizes, Nos. 7, 8 and 9, the following specifications being given for these three machines, respectively, in each case: Wheels recommended, 18 x 3 in., 20 x 3 in., 24 x 4 in.; diameter of arbor in collar, 1⅜ in., 1¾ in., 2 in.; length of arbor, 52 in., 60 in., 65 in.; distance between wheels, 40 in., 44 in., 48 in.; height to center of arbor, 34 in., 34 in., 34 in.; size of base, 23 x 24 in., 23 x 24 in., 25 x 38 in.; plain pulley, 7 x 5 in., 8 x 5½ in., 9 x 6 in.; speed of countershaft, 465, 382, 358 r.p.m.; weight, 700, 775, 1000 lb.

Milling and Shaping Machine

Cochrane-Bly Co., Rochester, N. Y.

"American Machinist," Aug. 7, 1919



Built as duplex universal milling and shaping machine, universal vertical milling machine, universal vertical shaping machine, plain vertical milling machine. Size of table inside oil pocket, 9 x 29 in.; longitudinal table travel, 18½ in.; transverse table travel, 9 in.; vertical table travel, 18 in.; size of 3 T-slots, ⅝ in.; adjustment of center head, 360 deg.; adjustment of milling head, front and back, 45 deg.; adjustment of shaping head, front and back, 40 deg.; speeds of milling spindle, 55 to 330 r.p.m.; maximum speed of high-speed milling attachment, 1400 r.p.m.; maximum distance from table to spindle, 20 in.; maximum distance from table to tool head, 18 in.; distance from center of spindle to column, 13 in.; strokes per minute, 25 to 150; taper hole in spindle, B. & S. No. 9; hole through spindle, 1⅛ in.; feeds per revolution of milling spindle, 0.002, 0.004, 0.006, 0.008, 0.016, and 0.024 in.; feeds per stoke of shaping ram, 0.0025 to 0.020 in.

Patented Aug. 20, 1918

The Weekly Price Guide of

IRON AND STEEL

PIG IRON—Quotations compiled by The Matthew Addy Co., as per Department of Commerce Committee Schedule.

	Current	One Year Ago
CINCINNATI		
No. 2 Southern	$30.35	$36.90
Northern Basic	27.55	27.55
Southern Ohio No. 2	28.55	28.55
NEW YORK—TIDEWATER DELIVERY		
2X Virginia (Silicon 2.25 to 2.75)	32.40	34.40
Southern No. 2 (Silicon 2.25 to 2.75)	35.20	33.95
BIRMINGHAM		
No. 2 Foundry	28.00	33.00
PHILADELPHIA		
Eastern Pennsylvania No. 2	30.65*	30.65
Virginia No. 2	32.10–34.10†	30.85
Basic	30.90*	29.90
Grey Forge	29.90*	29.90
CHICAGO		
No. 2 Foundry local	26.75	26.75
No. 2 Foundry, Southern	28.00	31.75
PITTSBURGH, INCLUDING FREIGHT CHARGE FROM VALLEY		
No. 2 Foundry	28.15	28.15
Basic	27.15	32.00
Bessemer	29.35	35.20

* F. o. b. furnace. † Delivered.

STEEL SHAPES—The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses at the cities named:

	— New York —			— Cleveland —		— Chicago —	
	Current	One Month Ago	One Year Ago	Current	One Year Ago	Current	One Year Ago
Structural shapes	$3.47	$3.47	$4.245	$3.37	$4.17	$3.47	$4.27
Soft steel bars	3.37	3.37	4.145	3.27	4.07	3.37	4.17
Soft steel bar shapes	3.37	3.37	4.145	3.27	4.17	3.37	4.17
Soft steel bands	4.07	4.07	4.995	....	....	....	....
Plates, ¼ to 1 in. thick	3.67	3.67	4.495	3.57	4.42	3.67	4.25

Note—For less than carload lots add 4½c. per 100 lb.

BAR IRON—Prices per 100 lb. at the places named are as follows.

	Current	One Year Ago
Mill, N. Y.	$2.77	$3.50
Warehouse, New York	3.37	4.75
Warehouse, Cleveland	3.27	4.10
Warehouse, Chicago	3.37	4.10

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the base quotations from mill:

Blue Annealed	Large Mill Lots Pittsburgh	St. Louis	Chicago	San Francisco	— New York — Current	One Yr. Ago
No. 10	3.55	4.64	4.57	5.80	4.57	5.495
No. 12	3.60	4.69	4.62	5.75	4.62	5.545
No. 14	3.65	4.74	4.67	5.90	4.67	5.595
Black						
*Nos. 18 and 20	4.15	5.24	5.17	6.75	5.30	6.295
*Nos. 22 and 24	4.20	5.29	5.22	6.80	5.35	6.345
*No. 26	4.25	5.34	5.27	6.95	5.40	6.395
*No. 28	4.35	5.44	5.37	7.05	5.50	6.495
Galvanized						
No. 10	4.70	5.79	5.97	....	6.20	6.845
No. 12	4.80	5.89	6.07	7.30	6.25	6.945
No. 14	4.80	5.89	6.07	7.30	6.30	6.945
Nos. 18 and 20	5.20	6.19	6.37	7.60	6.60	7.245
Nos. 22 and 24	5.25	6.34	6.52	7.75	6.30	7.295
*No. 26	5.40	6.04	6.67	7.90	6.45	7.445
*No. 28	5.70	6.79	6.97	8.20	6.75	7.745

* For painted corrugated sheets, add 30c. per 100 lb. for 25 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

COLD DRAWN STEEL SHAFTING—From warehouse to consumers requiring at least 1000 lb. of a size (smaller quantities take the standard extras) the following discounts hold:

	Current	One Year Ago
New York	5.00 base	List plus 12%
Cleveland	5% off	List plus 12%
Chicago	2% off	List plus 13%

DRILL ROD—Discounts from list price are as follows at the places named:

	Extra	Standard
New York	45%	50%
Cleveland	35%	35%
Chicago	35%	35%

SWEDISH (NORWAY) IRON—The average price per 100 lb., in ton lots is:

	Current	One Year Ago
New York	$21.00–26.00	$15.50–19
Cleveland	20.00	20.00
Chicago	16.50	19.00

In coils an advance of 50c. usually is charged.
Domestic iron (Swedish analysis) is selling at 15c. per lb.

WELDING MATERIAL (SWEDISH)—Prices are as follows in cents per pound f.o.b. New York, in 100 lb. lots and over:

Welding Wire		Cast-Iron Welding Rods	
1, 11/16, 5/8, 9/16, 1/2, 7/16 No. 8, 3/8 and No. 10	21.00 to 30.00	5/16 by 12 in. long	14.00
1/4 No. 12		1/4 by 19 in. long	12.00
3/16 No. 14 and 1/8 No. 18 No. 20		3/16 by 19 in. long	10.00
		1/4 by 21 in. long	10.00
		Special Welding Wire, Coated	
		1/4	33.00
		5/16	30.00
		3/8	28.00

Domestic 20c. for 1/16, 15c. for 1/8 to 3/16.

MISCELLANEOUS STEEL—The following quotations in cents per pound are from warehouse at the places named:

	New York Current	Cleveland Current	Chicago Current
Openhearth spring steel (heavy)	6.50	8.00	8.00
Spring steel (light)	10.00	11.25	11.75
Coppered bessemer rods	8.00	8.00	7.07
Hoop steel	4.07	4.75	4.07
Cold-rolled strip steel	8.40	8.25	8.10
Floor plates	5.67	6.00	5.92

Note—For less than carload lots add 4½c. per 100 lb.

PIPE—The following discounts are for carload lots f.o.b. Pittsburgh: basing card of National Tube Co. for steel pipe, Cardry A. M. Byer's Co. for iron, both dated Mar. 21, 1919.

Steel Inches	Black	Galvanized	Iron Inches	Black	Galvanized
BUTT WELD					
1/8, 1/4 and 3/8	50½%	24%	3/8 to 1¼	39½%	23½%
1/2	54½%	40%			
3/4 to 3	57½%	44%			
LAP WELD					
2	50½%	35%	2	32½%	18½%
2½ to 6	53½%	41%	2½ to 6	34½%	21½%
BUTT WELD, EXTRA STRONG PLAIN ENDS					
1/8, 1/4 and 3/8	46½%	29%	3/8 to 1¼	39½%	24½%
1/2	51½%	39%			
3/4 to 1¼	55½%	43%			
LAP WELD, EXTRA STRONG PLAIN ENDS					
2	48½%	37%	2	33½%	20½%
2½ to 4	51½%	40%	2½ to 4	35½%	23½%
4½ to 6	50½%	39%	4½ to 6	34½%	22½%

Stock discounts in cities named are as follows:

	— New York — Black	Galvanized	— Cleveland — Black	Galvanized	— Chicago — Black	Galvanized
¼ to 3 in. steel butt welded	47%	31%	43½%	34½%	57½%	44%
2½ to 6 in. steel lap welded	42%	27%	45½%	30½%	53½%	41%

Malleable fittings. Class B and C, banded, from New York stock sell at plus 12½% less 5%. Cast iron, standard sizes, 10–5% off.

METALS

MISCELLANEOUS METALS—Present and past New York quotations in cents per pound, in carload lots:

	Current	One Month Ago	One Year Ago
Copper, electrolytic	24.00	21.75	26.00
Tin in 5-ton lots	57.00	70.00	92.00
Lead	6.00	5.50	8.75
Spelter	8.15	8.00	9.00
ST. LOUIS			
Lead	5.65	5.25	8.50
Spelter	7.50	7.65	8.75

At the places named, the following prices in cents per pound prevail, for 1 ton or more:

	— New York — Current	One Month Ago	One Year Ago	—Cleveland— Current	One Year Ago	— Chicago — Current	One Year Ago
Copper sheets, base	33.50	29.50	38.00	35.50	38.00	36.50	33.50
Copper wire (carload lots)	28.25	26.00	35.00	30.50	35.00	26.00	33.00
Brass sheets	27.75	23.00	39.75	33.00	37.00	28.00	31.50
Brass pipe	36.00	34.00	46.00	39.00	42.00	37.00	41.50
Solder (half and half) (case lots)	45.00	45.00	60.00	41.00	57.50	38.50	56.00

Copper sheets quoted above hot rolled 16 oz., cold rolled 14 oz. and heavier, add 1c.; polished takes 1c. per sq.ft. extra for 20-in. widths and under; over 20 in., 2c.

BRASS RODS—The following quotations are for large lots, mill. 100 lb. and over, warehouse; net extras:

	Current	One Year Ago
Mill	$26.75	$32.25
New York	24.25	34.25
Cleveland	29.00	35.00
Chicago	27.00	29.50

Shop Materials and Supplies

ZINC SHEETS—The following prices in cents per pound prevail:

Carload lots f. o. b. mill 11.00

	In Casks		Broken Lots	
	Current	One Year Ago	Current	One Year Ago
Cleveland	12.50	18.75	13.00	18.40
New York	11.50	16.50	12.50	17.00
Chicago	16.50	22.00	16.00	21.50

ANTIMONY—Chinese and Japanese brands in cents per pound, in ton lots, for spot delivery, duty paid:

	Current	One Year Ago
New York	9.50	14.00
Chicago	10.25	15.25
Cleveland	12.00	16.25

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

	New York		Cleveland		
	Current	One Year Ago	Current	One Year Ago	Chicago
Copper, heavy and crucible	19.00	24.00	19.00	24.00	19.50
Copper, heavy and wire	18.00	22.50	18.00	23.50	19.00
Copper, light and bottoms	15.50	20.50	17.00	21.50	18.00
Lead, heavy	5.00	7.00	5.00		5.00
Lead, tea	3.75	5.25	3.50	7.50	4.00
Brass, heavy	12.50	14.75	14.00	16.00	18.50
Brass, light	8.50	11.00	10.50	12.50	11.50
No. 1 yellow brass turnings	10.00	13.50	11.50	14.00	11.75
Zinc	4.50	6.00	5.00	6.50	5.00

ALUMINUM—The following prices are from warehouse at places named:

	New York	Cleveland	Chicago
No. 1 aluminum, 98 to 99% pure, in ingots for remelting (1-15 ton lots), per lb.	35c.–37c.	32.00c.@33.00c.	33½c.

COPPER BARS from warehouse sell as follows in cents per pound, for ton lots and over:

	Current	One Year Ago
New York	33.00	32.00
Chicago	31.00	38.00
Cleveland	35.00	36.50

BABBITT METAL—Warehouse price per pound:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Best grade	90.00	125.00	75.00	103.00	72.00	100.00
Commercial	50.00	70.00	16.50	23.00	18.00	24.00

SHOP SUPPLIES

New York prices will be revised in next week's issue.

NUTS—From warehouse at the places named, on fair-sized orders, the following amount is deducted from list:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Hot pressed square	$1.50	+$2.50	$2.25	$1.20	$2.00	$1.05
Hot pressed hexagon	1.50	+2.50	2.25	1.00	2.00	.85
Cold punched hexagon	1.50	+2.50	2.25	.75	1.30	1.00
Cold punched square	1.50	+2.50	2.25	.75	1.30	1.00

Semi-finished nuts sell at the following discounts from list price:

	Current	One Year Ago
New York	50-10%	50%
Chicago	50%	50%
Cleveland	60-10-10%	50%

MACHINE BOLTS—Warehouse discounts in the following cities:

	New York	Cleveland	Chicago
¾ by 4 in. and smaller	50%	50%	50–10%
Larger and longer up to 1½ in. by 30 in.	40%	40%	40–10%

WASHERS—From warehouses at the places named the following amount is deducted from list price:

For wrought-iron washers:

New York.....$1.25 Cleveland.....$3.75 Chicago.....$2.25

For cast-iron washers the base price per 100 lb. is as follows:

New York.....$6.00 Cleveland.....$3.75 Chicago.....$4.00

CARRIAGE BOLTS—From warehouses at the places named the following discounts from list are in effect:

	New York	Cleveland	Chicago
¾ by 6 in. and smaller	45–5%	40–5%	50%
Larger and longer up to 1 in. by 30 in.	35%	37½%	50–5%

COPPER RIVETS AND BURS sell at the following rate from warehouse:

	Rivets		Burs	
	Current	One Year Ago	Current	One Year Ago
Cleveland	20%	List plus 10%	10%	List plus 10%
Chicago	20%	List price	20%	List plus 20%
New York	40%	20% from list	20%	List plus 20%

RIVETS—The following quotations are allowed for fair-sized orders from warehouse:

	New York	Cleveland	Chicago
Steel ½ and smaller	50–10%	55% off	45%
Tinned	50–10%	55% off	40%

Boiler, ½, ⅝, 1 in. diameter by 2 in. to 5 in. sell as follows per 100 lb.:

New York...$5.25 Cleveland...$4.00 Chicago....$4.87 Pittsburgh...$4.65

Structural, same sizes:

New York...$5.35 Cleveland...$4.10 Chicago....$4.97 Pittsburgh...$4.75

MISCELLANEOUS

SEAMLESS DRAWN TUBING—The base price in cents per pound from warehouse in 100-lb. lots is as follows:

	New York	Cleveland	Chicago
Copper	37.50	40.50	38.50
Brass	36.00	39.00	37.00

For immediate stock shipment 3c. is usually added. The prices, of course, vary with the quantity purchased. For lots of less than 100 lb., but not less than 75 lb., the advance is 2c.; for lots of less than 75 lb., but not less than 50 lb., the advance is 5c. over base (100-lb. lots); for less than 50 lb., but not less than 25 lb., 10c. should be added to the base price; and for quantities of from 10 to 25 lb. the extra is 25c.; less than 10 lb., add 35c.

Double above extras will be charged for angles, channels and sheet-metal mouldings if ordered in above quantities. The above extras also apply to brass rod other than standard stock sizes—stock sizes being considered as ¼ up to 2 in. inclusive in rounds, and ¼ up to 1½ in., inclusive in square and hexagon—all varying by thirty-seconds up to 1 in. and by sixteenths over 1 in. On all shipments aggregating less than 100 lb. there is usually a boxing charge of $1.50.

LONG TERNE PLATE—For No. 28 primes, from Stock, the price in Chicago is $7.50 per 100 lb.

COTTON WASTE—The following prices are in cents per pound:

	New York		Cleveland	Chicago
	Current	One Year Ago		
White	13.00	11.00–13.00	14.00	11.00 to 14.00
Colored mixed	9.00 to 12.00	8.50–12.00	11.00	9.50 to 12.00

WIPING CLOTHS—Jobbers' price per 1000 is as follows:

	13½ x 13½	13½ x 20½
Cleveland	52.00	58.00
Chicago	41.00	43.50

SAL SODA sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$1.75	$1.75	$1.75
Philadelphia	1.75	1.75	1.75
Cleveland	2.75	2.75	2.40
Chicago	2.00	2.00	2.00

ROLL SULPHUR in 360-lb. bbl. sells as follows per 100 lb.:

	Current	One Month Ago	One Year Ago
New York	$3.65	$3.65	$4.30
Cleveland	3.62	3.62	4.60
Chicago	4.12½	4.125	4.00

COKE—The following are prices per net ton at ovens, Connellsville, and cover the past five weeks:

	Aug. 21	Aug. 14	Aug. 7	July 31	July 24
Prompt furnace	$4.00	$3.90	$3.90	$3.85	$4.00
Prompt foundry	5.50	5.25	5.00	5.00	5.00

FIRE CLAY—The following prices prevail:

		Current
Ottawa, bulk in carloads	per ton	$8.00
Cleveland	375-lb. bag	2.50

LINSEED OIL—These prices are per gallon:

	New York		Cleveland		Chicago	
	Current	One Year Ago	Current	One Year Ago	Current	One Year Ago
Raw in barrels (5 bbl. lots)	$2.25	$1.86	$2.15	$2.10	$2.48	$2.05
5-gal. cans	2.40	1.96	2.40	2.25	2.68	2.25

WHITE AND RED LEAD—Base price per pound:

	Red				White	
	Current		1 Year Ago		Current	1 Year Ago
	Dry	In Oil	Dry	In Oil	Dry and In Oil	Dry and In Oil
100-lb. keg	13.00	14.50	14.00	14.50	13.00	14.00
25 and 50-lb. kegs	13.25	14.75	14.25	14.75	13.25	14.25
12½-lb. keg	13.50	15.00	14.50	15.00	13.50	14.50
5-lb. cans	15.00	16.50	.....	.....	15.00	16.00
1-lb. cans	16.00	17.50	.....	.....	16.00	17.00

500 lb. lots less 10% discount; 2000 lb. lots less 10-2½% discount.

NEW AND ENLARGED SHOPS

Consult the Buying Section when in need of machinery or supplies

Metal Working

NEW ENGLAND STATES

Conn., Danbury—The Standard Oil Co., Shelter Rock Rd., has awarded the contract for a 1 story, 30 x 45 ft. garage, a 1 story, 11 x 45 ft. heater building and a 1 story pump house. Estimated cost, $22,000.

Conn., Hartford—The Hall-Thompson Co., 844 Windsor St., manufacturer of automobiles, plans to build a 3 story, 35 x 60 ft. addition to its factory. Estimated cost, $26,000.

Conn., Hartford—The Whitney Manufacturing Co., Bartholomew Ave., manufacturer of chains, plans to build a 4 story, 58 x 112 ft. factory. Boring & Tilton, 52 Vanderbilt Ave., New York City, Arch and Engr.

Conn., Meridan—The M. B. Schenck Co., Center St., manufacturer of hardware specialties, has awarded the contract for a 2 story, 53 x 64 ft. addition to its factory. Estimated cost, $22,000. Noted Aug. 7.

Conn., New Haven—M. Massari, 142 Bradley St., will build a 1 story, 55 x 86 ft. garage with two 16 x 48 ft. ells. Estimated cost, $25,000. Noted July 10.

Conn., New Haven—New Haven Stove Repair Co., 488 State St., plans to build a 1 story, 60 x 105 ft. garage. Estimated cost, $25,000. J. Weinstein, 6 Church St., Arch.

Mass., Mittineague (West Springfield P. O.)—The Strathmore Paper Co. has awarded the contract for a 4 story, 78 x 98 ft. factory, to be erected on Plant St. Estimated cost, $70,000.

Mass., Springfield—A. Freedman, 27 Church St., plans to build a 1 story, 70 x 107 ft. garage on Liberty St. Estimated cost, $25,000.

Mass., Worcester—F. W. Lewis, 384 Pleasant St., plans to build a 1 story, 55 x 120 ft. garage. Estimated cost, $30,000. E. T. Chapin, State Mutual Bldg., Arch.

R. I., Providence—The D. M. Watkins Co., 95 Pine St., manufacturer of jewelers' findings, is having preliminary plans prepared for a 2 story, 100 x 125 ft. factory, on Pine and Foster Ave. Estimated cost, $70,000. W. R. Walker & Son, 17 Custom House St., Arch.

MIDDLE ATLANTIC STATES

N. J., Trenton—The Ingersoll Trenton Watch Co., Monmouth St., has awarded the contract for a 1½ story, 21 x 99 ft. factory. Estimated cost, $13,000.

N. Y., Albany—The Kelly-Dennin Co., plans to build a 1 story, 150 x 150 ft. garage, machine shop and salesroom, on Broadway. Estimated cost, $150,000.

N. Y., Buffalo—The Quale Public Garage Co., 2675 Main St., plans to build a 2 story garage, on Main and Rockney St. Estimated cost, $40,000.

N. Y., Geneva—The O'Malley Motor Co. plans to build a 3 story, 50 x 100 ft. garage, machine shop and service station, on Canal and Exchange St. Estimated cost, $50,000.

N. Y., New York (Borough of Bronx)—J. Brown, 521 East 149th St., will build a 1 story garage on Tinton Ave. and 147th St. Estimated cost, $15,000.

N. Y., New York (Borough of Bronx)—The Payne Estate, Inc., c/o H. L. Brandt, Arch., 38 Marble Hill Ave., will build a 1 story, 75 x 100 ft. garage on 140th St. and Morris Ave. Estimated cost, $10,000.

N. Y., New York (Borough of Brooklyn)—P. J. Carroll, 141 96th St., will build a 1 story garage on 4th Ave. and 92nd St. Estimated cost, $30,000.

N. Y., New York (Borough of Brooklyn)—The Coney Island Building Corporation, 44 Court St., will build a 1 story, 75 x 135 ft. garage at 954 Fulton St. Estimated cost, $25,000. L. Gold, Pres.

N. Y., New York (Borough of Brooklyn)—S. Greenstein, 206 West 29th St., will build a 1 and 2 story garage on Flushing Ave., to cover 16,000 sq.ft. of floor space.

N. Y., New York (Borough of Brooklyn)—Smith Builders, 142 East 43rd St., will build a 1 story, 70 x 130 ft. garage, on 4th Ave. and 62nd St. Estimated cost, $40,000.

N. Y., New York (Borough of Manhattan)—F. Alberti, 186 Bleeker St., is having plans prepared by F. E. Vitolo, Arch. and Engr., 56 West 45th St., for a 1 story, 59 x 83 ft. garage, to be erected on 68th St. and 7th Ave. Estimated cost, $30,000.

N. Y., New York (Borough of Manhattan)—C. Cory & Co., 290 Hudson St., is having plans prepared by R. C. Cory, Arch. and Engr., 39 Cortlandt St., for a 6 story, 75 x 150 ft. factory, for the manufacture of electrical supplies. Estimated cost, $200,000.

N. Y., New York (Borough of Manhattan—D. Golden, 150 Broadway, is having plans prepared by P. J. Murray, 141 East 40th St., for a 4 story, 100 x 100 ft. service station, to be erected at 229 West 60th St. Estimated cost, $80,000.

N. Y., New York (Borough of Queens)—L. Gold, 44 Court St., Brooklyn, will build a 5 story, 100 x 175 ft. garage, on 7th St. and Pierce Ave., Long Island City. Estimated cost, $220,000.

N. Y., New York (Borough of Queens)—L. Gold, 44 Court St., will build a 2 story, 100 x 150 ft. garage on 8th St. and Jackson Ave., Long Island City. Estimated cost, $50,000.

N. Y., New York (Borough of Queens)—The W. C. Van Brunt Iron Works, 14th Ave., plans to build a 300 x 310 ft. factory on Bordon Ave., between Marsh and Fox St., Long Island City.

N. Y., New York (Borough of Queens)—The Wappler Electric Co., Harris Ave., has awarded the contract for a 2 story, 175 x 225 ft. factory, to be erected on Van Alst and Harris Aves.

N. Y., Syracuse—The Dyneto Electric Co., Wolf and Park St., manufacturer of automobile electric parts, plans to build a 1 story, 70 x 200 ft. factory, on Wolf St. Estimated cost, $50,000.

Penn., Harrisburg—The Packard Motor Car Co., 317 North Broad St., Philadelphia, has awarded the contract for a 1 story, 140 x 150 ft. service station and salesroom. Estimated cost, $70,000.

Penn., Philadelphia—M. L. Bayard & Co., 20th and Indiana Sts., manufacturer of gears and automobile parts, has awarded the contract for a 1 story, 48 x 60 ft. factory.

Penn., Philadelphia—The Comery Schwartz Motor Car Co., 128 North Broad St., is having plans prepared by C. E. Oelschlager, Arch., 1615 Walnut St., for a 6 story, 210 x 440 ft. auto service and truck station, at 21 Market St.

Penn., Phialdelphia—The Hartford Realty Co., 1425 North Broad St., has awarded the contract for a 2 story, 30 x 160 ft. garage and salesroom. Estimated cost, $20,000. Noted July 31.

Penn., Philadelphia—The Hess-Bright Co., Frost and Erie Sts., manufacturer of ball bearings, plans to build a 2 story, 42 x 105 ft. factory.

Penn., Pittsburgh—A. W. Mellen, Woodland Rd., has awarded the contract for a 2 story, 50 x 120 ft. garage, to be erected on Baum Blvd. Estimated cost, $35,000. Keystone Buick Co., Baum and Euclid St., Lessee.

MIDDLE WEST

Ill., Chicago—A. M. Harroun, 5501 Cornell Ave., plans to build a 1 story, 100 x 150 ft. garage, on Lake Park Ave. and 55th St. Estimated cost, $25,000. Z. E. Smith, 5501 Prairie Ave., Arch.

Ill., Chicago—G. K. Heiser, 1916 Webster Ave., has awarded the contract for a 1 story, 50 x 100 ft. garage, to be erected at 1912 Webster Ave. Estimated cost, $10,000.

Mich., Bay City—J. P. Beck, Saginaw, Mich., plans to build a 3 story, 100 x 100 ft. garage, on Washington St. here. Estimated cost, $75,000.

Mich., Detroit—A. Harvey's Sons Manufacturing Co., 1st St., manufacturer of plumbing supplies, has awarded the contract for a 1 and 2 story, 60 x 100 ft. foundry, to be erected on Bellevue Ave., near the Michigan Central RR.

Mich., Detroit—The Packard Motor Car Co., East Grand Blvd., has awarded the contract for a 4 story, 80 x 196 ft. and 80 x 201 ft. service station, on Woodbridge and St. Antoine St.

Mich., Detroit—The Studebaker Corporation, Brush St. and Harper Ave., manufacturer of automobiles, has awarded the contract for a 1 story, 40 x 200 ft. crane shed on Brush St.

Mich., Detroit—The Swedish Crucible Steel Co., Butler St., and Grand Trunk Ry., has awarded the contract for a 1 story, 240 x 240 ft. factory, to be erected on Conant Ave. Noted Aug. 7.

Mich., Grand Rapids—The French Oil Machinery Co., Piqua, Ohio, is having plans prepared by J. J. Wernette Engineering Co., Engr., Grand Rapids, for a 50 x 100 ft. factory to be erected here, for the manufacture of conveying machinery equipment.

Mich., Greenville—The Moore Plow and Implement Co. plans to build a 1 story, 50 x 80 ft. foundry. F. P. Allen & Son, Grand Rapids, Arch.

Mich., Highland Park (Detroit P. O.)—The Maxwell Motor Car Co., Oakland Ave., will build a 1 and 2 story, 315 x 557 ft. factory, for sheet metal work.

Ohio, Cleveland—The Jordon Motor Car Co., 1057 East 152nd St., has awarded the contract for a 2 story, 97 x 167 ft. addition to its plant. Estimated cost, $75,000. Noted Aug. 7.

Ohio, Cleveland—M. S. Kohn, 991 East Blvd., plans to build a 4 story, 75 x 235 ft. garage and theater, at 3910 Lorain Ave. Estimated cost, $150,000.

Ohio, Cleveland—The National Lamp Works, Nela Park, has awarded the contract for a 2 story, 64 x 139 ft. service station. Estimated cost, $150,000. Noted Aug. 7.